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The Pennsylvania State College
The Graduate School
Department of Forestry

Bob-white Cover In Franklin County, Pennsylvania

A Thesis

by

David Hall Jenkins

Submitted in partial fulfillment
of the requirements
for the degree of
Master of Science

May, 1942

Approved Apr. 27, 1942

Victor A. Beede
Head, Department of Forestry

April 28, 1942

William C. Bramble
Associate Professor
Department of Forestry

April 27, 1942

Lagan J. Bennett
Leader, Pennsylvania Cooperative
Wildlife Research Unit

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The writer was employed as a graduate assistant in the Department of Forestry of The Pennsylvania State College and worked under the direction of the Pennsylvania Cooperative Wildlife Research Unit. Financial support for the unit was obtained from the Pennsylvania State College, the Pennsylvania Game Commission, the United States Fish and Wildlife Service, and the American Wildlife Institute.

INTRODUCTION

In spite of the fact that the Eastern Bob-white (Colinus virginianus virginianus) is not the most numerous of Pennsylvania's game birds, it is one of the most popular of all game species in this state. The maintenance of a high quail population in south central Pennsylvania is an important part of the work of the Pennsylvania Game Commission. In an attempt to learn something of the cover requirements of the Eastern Bob-white, a two year ecological study was undertaken in Franklin County on July 1, 1940, by the Pennsylvania Cooperative Wildlife Research Unit.

Errington and Hamerstrom (1936) have shown that the density of population in the northern part of the Bob-white range depends almost entirely upon the carrying capacity of the winter range. Carrying capacity of any covey range not only depends on the amount of food and cover, but, in a more important way upon the dispersion of that food and cover. It was the purpose of this survey to seek both quantitative and qualitative information on a number of covey ranges.

It was found that a covey of approximately the same size was usually found in the same territory year after year. Such established ranges were used as study areas in order to determine the food and cover requirements of the Bob-white. Food and cover were considered of equal importance because the presence of one without the other indicated low quality quail range. Errington (1939) found that quail can stand temperatures as low as -35 degrees Fahrenheit if they are well fed and protected from high wind.

Because of the importance of winter food and cover, more stress was placed on winter observations than on the remainder of the year; however, from April 15 to September 15, 1941, a study was made of the cover requirements during the period of nesting and rearing of young.

During two summer periods (1940 and 1941) both Ralph I. Blough and the writer were located in Franklin County and conducted their field work in close cooperation. From September 15, 1940, to February 1, 1941, the writer spent full time in the field while Mr. Blough attended classes. During the spring semester the workers exchanged positions. From September 15, 1941 to February 1, 1942 the writer attended class and Mr. Blough conducted the field work. During the spring of 1942 Mr. Blough returned to class and the writer spent full time in the field.

The advancement of the commencement date of the Pennsylvania State College in 1942 made it impossible to include data gathered during the spring of 1942 in this report. The writer realizes that in a short period of two years only a relatively small amount of data could be collected. Therefore continued work along the same line must be conducted if the knowledge gained herein is to be put to good advantage.

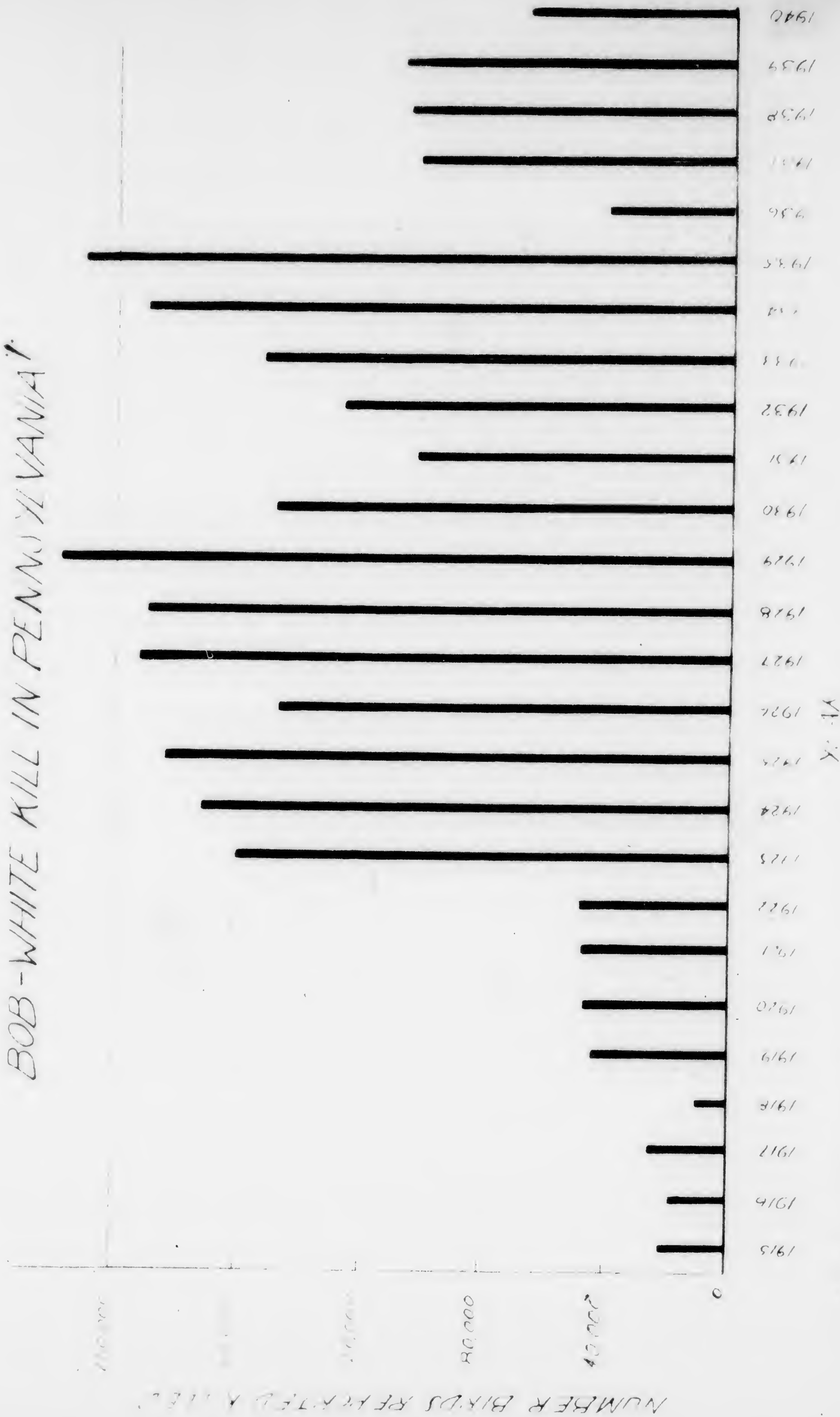
HISTORY OF QUAIL IN FRANKLIN COUNTY

The history of the Bob-white in Franklin county is typical of quail in south-central Pennsylvania. This portion of the state lies in the northern part of the natural range of the Eastern Bob-white. It may be noted in Figure 1 that the annual quail kill in Pennsylvania fluctuates greatly. If it is assumed that the annual reported kill is indicative of the total quail population in the state it is evident that some factor or factors are responsible for the periodic declines and subsequent increases in the quail population.

It is thought that the periodic severity of winters in south-central Pennsylvania is the greatest factor in preventing the quail from reaching and maintaining a high population. On that basis the deep persistent snows and prolonged low temperatures that occurred during the winter of 1935-36 were held responsible for the death of approximately 70 percent of the total quail population of Franklin County. Old residents of the county recall years previous to 1936 when it was possible to find 15 or 20 different coveys in an early morning stroll through the fields. Today, however, it is possible to wander about over the same areas for several days without flushing a single covey.

Losses such as were encountered during the winter of 1935-36 are not uncommon in other parts of the bob-white's northern range. Leopold (1937) reported as high as 83 percent of the resident quail population in southwestern Wisconsin were lost during the winter of 1935-36. Green, and Beed (1936) reported a mortality of 63 percent of the quail in Iowa, and Errington (1941) recorded deaths of 80 percent

Figure 1
BOB-WHITE KILL IN PENNSYLVANIA



of the bob-whites in central Iowa during the same winter.

In previous years various methods have been attempted to restock the depleted coverts. Game farm quail have been planted in both spring and fall, bag limits and other restrictions have been enforced and predator control has been carried out to some extent.

THE STUDY AREA

Location and Geologic Description

After conference with Mr. Richard Gerstell of the Pennsylvania Game Commission, Franklin County was chosen as the best area in which to work. This county was typical of the south-central part of the state, and the cooperation of the local game protector was readily obtained. The quail population in Franklin County was reputed to be higher than in other parts of the state and, therefore, could provide more material for study.

Franklin County is roughly triangular in shape and includes an area of approximately 768 square miles. Most of the county lies in that part of the state known as the Cumberland Valley which constitutes the northward continuation of the Shenandoah Valley of Virginia. The southern boundary is formed by the Pennsylvania-Maryland state line and extends for a distance of 34 miles.

Chambersburg, the county seat, is near the center of the county and is approximately 53 miles southwest of Harrisburg and 140 miles west of Philadelphia.

The Cumberland Valley occupies part of the eastern edge of the Appalachian Valley division, which is the central division of the Appalachian geographical province. The Blue Ridge Mountains form a band of mountains and valleys six to eight miles wide along the western edge of the county, while the South Mountains occupy a five mile wide-area in the eastern portion.

The Cumberland Valley between the Blue Ridge and South Moun-

tains is the widest valley in the county and ranges in width from 13 miles in the northern part to 25 miles in the southern part. Path Valley, in the northwestern part of the county is similar to the Cumberland Valley in many respects, but is much narrower, being only from one to five miles wide. Numerous other narrow mountain valleys are present but except for the Little Cove Valley in the southwestern part of the county, do not constitute any of the natural quail range.

The main valley floors are gently rolling to smooth plains with scattered rounded hills. The differences in relief in different parts of the valley are largely due to different degrees of resistance to weathering and erosion of the underlying geologic formations. Areas of flat topped tableland are underlain by massive beds of mud shales. Hard limestone or dolomite produce more choppy or jagged relief and such areas are known as limestone reefs. Many of the better quail ranges are located in these areas. Limestone outcroppings are usually overgrown with brush and weeds and provide well distributed cover (fig. 2). Areas underlain by softer limestone are generally gently rolling.

The drainage channels parallel the valleys for long distances and usually follow the route of least resistance. Generally speaking, most of the land is well drained and very few poorly drained areas or stagnant swamps occur.



**Fig. 2. Limestone "reefs" overgrown with
brush provided small areas of
well distributed cover.**



Fig. 2. Limestone "reefs" overgrown with
brush provided small areas of
well distributed cover.

Agricultural History and Practices

Before the white man came to the Cumberland Valley, a mixture of wild grasses (Graminae), sedges (Carex spp.), brush and scattered trees occupied the limestone belt. Grasses, laurel (Kalmia latifolia), persimmon (Diospyros virginiana), hawthorn (Corylus americana), wild plum (Prunus sp.), juniper (Juniperus sp.), wild currants (Ribes spp.), blackberry (Rubus allegheniensis), raspberry (Rubus occidentalis), spice bush (Benzoin aestivale), sumac (Rhus spp.), dewberry (Rubus villosus), and wintergreen (Gaultheria procumbens), occurred in the grasslands and open wooded areas. Black walnut (Juglans nigra), red oak (Quercus borealis), white oak (Q. alba), hickories (Hicoria spp.), red maple (Acer rubrum), sugar maple (A. saccharum), wild black cherry (Prunus serotina), black locust (Robinia Pseudo-acacia), white ash (Fraxinus americana), American elm (Ulmus americana), basswood (Tilia glabra), and beech (Fagus grandifolia) occurred along the streams and moist areas. The mountainous areas were covered with dense forests of oaks and chestnut (Castanea dentata), however, some scattered pines (Pinus spp.), occurred on the ridge tops and talus slopes.

Beginning soon after 1780 and continuing until 1900, iron smelting operations were accompanied by clear cutting of the mountain timber. Today, as a result of continued clearcutting, the mountain forests are composed practically of all young trees. As the county developed and the roads were opened, wheat (Triticum aestivum) became an important export grain crop. Corn (Zea mays) was grown in large quantities to feed the cattle and hogs. Since 1910 livestock

feeding has given way to dairying, and, fruit growing has become very important.

The present complex agricultural system is built upon diversified farming, livestock production, dairying, and fruit growing. Corn, wheat, rye (*Secale cereale*), oats (*Avena sativa*), barley (*Hordeum vulgare*), and buckwheat (*Fagopyrum esculentum*) are the most important cereal crops. The important hay crops are red clover (*Trifolium pratense*), timothy (*Phleum pratense*), and alfalfa (*Medicago sativa*). Lespedeza (*Lespedeza striata*) is becoming increasingly popular as a hay and soiling crop in the southern part of the county. Potatoes (*Solanum tuberosum*), tomatoes (*Lycopersicon esculentum*), peas (*Pisum* spp.) and beans (*Phaseolus* spp.) are the important commercial crops, while pasture grasses consist mainly of timothy and clover mixed, and Kentucky blue grass (*Poa pratense*).

Crop rotation is important in the management of any area for quail in that it plays an important part in determining the presence or absence and dispersion of food and cover. In Franklin County corn is followed by wheat, rye, or barley which is followed by two years of hay. Very little oats is included in the present rotation. The acreage allotted to this crop (oats) has been becoming increasingly smaller since 1879. Buckwheat and truck crops are often included in the rotation when a cash crop is desired. Occasionally corn followed by two years of wheat and ending with a hay crop is used. When this rotation is practiced, the timothy is sown in the fall with the second wheat crop and only one crop of timothy is mowed and the stubble used for summer pasture.

Corn is usually cut and picked by hand in the field. Very little corn is allowed to remain standing over winter since it is commonly used for ensilage. When corn remains in the field over winter it is sheeked and winter wheat is planted in the available rows. It is a common practice to permit the pasturing of all stubble fields.

Alfalfa is an important source of hay and three crops are usually cut each year. The first crop is cut in June; the second in July and the third in late August. Timothy, red clover, and sweet clover (Melilotus alba) are usually mowed but once each year. All sod is plowed under in the spring of the second year before corn is planted. It is not uncommon to permit alfalfa to remain for as long as four years before planting corn.

Tomatoes are the most important truck crop in all parts of the county with the exception of Path Valley. Large quantities of tomatoes are used for canning purposes and hence only the best fruits are utilized.

Most small orchards are uncultivated or only occasionally disked. Foxtail grass (Setaria glauca) frequently forms a dense mat of ground cover in such orchards. The large orchards are well cultivated and usually provide little or no cover suitable for quail. However, in some of these, buckwheat is planted.

Climate

The climate of Franklin County is typical of south-central Pennsylvania. Prevailing winds are from the west and the valleys are protected from strong wind and storms by flanking mountain ranges.

Generally speaking, the winters are cloudy and damp but not extremely cold, the temperature rarely going below zero. The length of time that the ground remains covered with snow varies greatly. Some winters the snow cover is persistent for long periods while during others the ground is covered only part of the time. The winter of 1940-'41, with 35 inches of snowfall, was a nearly average winter (28.5 inches of snow is average for this county). During the period from December 15 to January 28, numerous snow and ice storms occurred; however, at no time did the snow cover exceed 1.5 inches. Two six-inch snowfalls occurred from January 28, to March 1 and the ground was completely covered during this time. Although a 12 inch and 8 inch fall occurred on March 8 and 12 respectively, the ground was almost entirely bare by March 16. Temperatures during the winter of 1940-41 were nearly average. The Chambersburg weather station recorded only a few days on which the temperature dropped below 10 degrees F. Temperatures of 22 degrees to 32 degrees prevailed during the early morning hours during the most of the winter. This compares favorably with the normal daily average of 31 degrees for the winter months.

The snowfall of 1941-'42, which amounted to 14 inches, was far below average. No snow of any appreciable depth or persistence fell prior to January 3. At that time 6 inches of dry snow fell and the temperature dropped to 5 to 10 degrees below zero in the early mornings for a period of five days. The ground was covered for 12 days. Three inches of wet snow fell on February 5, but melted away within 24 hours and on March 3, a 4 inch snowfall occurred but disappeared entirely by March 6.

Significant differences in temperature were recorded between the northern and southern parts of the county. Minimum and maximum recording thermometers, placed in easily accessible parts of the county, showed that throughout the fall and the winter, the temperature in the southern townships averaged 3 to 6, and often as much as 10, degrees lower than in the northern part of the county. There was, however, no great differences between these areas in summer and late spring. The snow cover lasted considerably longer in the northern part of the county than in the central and southern part, and portions of the northern tier of townships received frequent light snowfalls when the southern parts experienced rainstorms.

During the nesting season of 1941 (April, May, June, July, August) the rainfall in Franklin County was 18.14 inches. This amount compares favorably with the average for the county which is 18.37 inches. Precipitation did not occur equally distributed during the period but between long dry intervals. The mean temperature for the period from April 1, to August 31, 1941 was 66.6 degrees. This was 1.2 degrees above the all time average for these months.

The average frost free season is about 160 days. In 1941 the last frost occurred on May 25 and the first killing frost on October 10, a period of 138 days.

Occasional periods of mild weather normally occur in winter and hence the soil is subject to alternate freezing and thawing. This condition during wet winters sometimes causes excessive frost heaving and winter killing of alfalfa, clover, and orchard trees.

PRELIMINARY SURVEY OF FRANKLIN COUNTY

The investigation was begun on July 5, 1940. Base maps were made from United States Geological Survey maps. On these maps both main highways and connecting roads were shown, and various important localities were named to facilitate describing the covey ranges. As a result of an initial extensive investigation, it was possible to classify different parts of the county as "good", "fair", or "poor" quail territory. This classification was accomplished in two ways: (1.), Inquiries were made of farmers and sportsmen as to the quail population on their farms and hunting grounds, and (2), The quality of the cover as adapted for quail was noted from roadside observation. In numerous cases the two methods gave similar results; however, a few areas that were classified as good quail range did not, after intensive investigation, yield as high a population as some areas that were originally classified as poor or fair. However, the main purpose of the extensive survey was to enable the investigators to pick likely areas on which to find as many coveys of quail as was possible in the shortest possible time.

METHODS OF COVER MAPPING AND MEASURING VEGETATION

As soon as it was possible to obtain definite information on the movement and habits of each covey of quail, a cover map was made of their range. By covey range is meant the territory inhabited by a covey of quail which the birds leave only under exceptional conditions such as: abnormally severe climatic conditions, scattering by hunters, and predators. Each range supplies the covey with food, cover, and other needs.

The range of each covey was determined after consolidating information obtained through observations of the birds and their signs, and from reports of farmers and sportsmen.

Throughout the fall and early winter a trained bird dog was used to locate coveys with considerable success. However, throughout most of the winter and early spring, snow tracking was regularly employed as a method of locating quail.

The investigators had several hundred postcards printed on which the return postage had been paid. Each card contained blanks in which information to help the investigators locate coveys might be written. These were distributed among farmers and sportsmen in hopes that the coveys seen in hunting season by these men could be found later and studied. However, this method proved unsatisfactory as only a few cards were returned and most of these expressed the opinion that additional game farm birds should be stocked in the neighborhood of the sender's favorite hunting ground.

Aerial photographs of Franklin County were made available through the cooperation of the Agricultural Conservation Association. The photographs were printed to a scale of 8 inches to the mile and were of sufficient clarity to allow the tracing of roads, streams, houses, field boundaries, fence rows and woodlots. Tracings of areas included in each covey range were made on transparent paper. These outlines were then taken into the field, where the details were added and the maps completed. After a map was obtained for each covey range, it was traced in black India ink on tracing linen from which photostat copies or blueprints can be made.

The age of trees was determined by the use of an increment borer. The cores were taken approximately 4.5 feet above the ground. Diameter of trees were also measured at 4.5 feet above the ground.

For the purposes of this investigation the density and concealment qualities of fence row vegetation was classified as simply "good", "fair", or "poor". A fence row was considered to be good, or number III if it consisted of enough of the proper kinds of vegetation to shelter quail when there was snow on the ground; (fig. 3); fair, or number II, if it was dense enough to shelter quail from predators and normal winter weather conditions only when there was no snow on the ground (fig. 4); and poor, or No. I, if it offered little or no winter cover for quail (fig. 5).

It will be readily seen that such a classification cannot be based on size and density alone but must include a consideration of the species composition. For example, a fence row 4 feet wide in which sumac or ailanthus (Ailanthus altissima) (fig. 6) was the dominant species would not furnish as good protection when there was snow on the ground as one of the same width composed largely of blackberry, black locust, and Japanese honeysuckle (Lonicera japonica).

In order to accurately measure the density of the vegetation in fence rows, idle and waste areas, and brushland, it was necessary to lay out sample plots. The size of these plots varied with the vegetation that was to be measured. On areas where the vegetation was dense, such as grass fields or idle fields, with a dense herbaceous growth, plots of one square foot were all that was required. However, in thickets of sumac, blackberry, raspberry, and similar



Fig. 3. A dense, or No. III, fence row composed of wild black cherry, hackberry, blackberry, red maple and Japanese honeysuckle.



Fig. 3. A dense, or No. III, fence row composed of wild black cherry, hackberry, blackberry, red maple and Japanese honeysuckle.



Fig. 4. A fence row of medium, or No. II, density.



Fig. 4. A fence row of medium, or No. II, density.



Fig. 5. Fence rows of No. 1 density provided little cover when the ground was bare and no cover when the ground was covered with snow.



Fig. 5. Fence rows of No. 1 density provided little cover when the ground was bare and no cover when the ground was covered with snow.



Fig. 6. Fence rows composed of Ailanthus and plants of similar form did not provide good winter cover for quail.



Fig. 6. Fence rows composed of Ailanthus and plants of similar form did not provide good winter cover for quail.

plants, plots covering one square yard were used. In order to lay out such plots accurately and rapidly, a six foot folding rule was used. For the small plots the rule was folded in such a manner to form a square covering one square foot. For the large plots, the ruler was folded at the 36 inch mark to form a 90 degree angle. It was then superimposed on the area to be measured and the boundaries of the remaining two sides were estimated and the number of stems within the square counted.

Weed fields in which the vegetation averaged 250 to 400 stems per square yard were considered as very dense and were usually found on the best covey ranges. Vegetation with a density of from 100 to 250 stems per square yard was considered to be of medium density, while densities under 100 stems per square yard indicated light growth or low density. The presence of dense vegetation did not necessarily indicate good quality quail range nor did the presence of vegetation of low density indicate poor quail range. However, the vegetative cover on waste lands on the best and poorest ranges was usually found to be of heavy and light density respectively.

CLASSIFICATION OF BOB-WHITE RANGES

After some experience in studying various territories inhabited by coveys of quail it was possible to evaluate the relative quality of each covey range and to determine roughly from previous experience what constituted good, fair, or poor quail range. However, it was found wise not to base an opinion on personal judgement alone but rather to have some definite thing upon which to base an opinion--some kind of "yardstick" for measuring the suitability of a given area for quail.

In Franklin County quail depend on unpastured woodlots, dense fence rows, and brushland for winter cover, corn, small grains, and patches of fruits and berries for the summer food supply, low grass and weeds for nesting and roosting, and areas on which the mineral soil was exposed for dusting and obtaining grit.

Description of a Typical Good to Excellent Covey Range

No covey range has all the requirements with the ideal amount and dispersion of cover. Some ranges, however, come fairly close to supplying all the needs of a covey of quail from year to year. Throughout the course of the investigation 53 bob-white ranges were studied. Of this number, 12 or 23 percent were classified as good to excellent. In order to be classified as such, a covey range had to supply all, or nearly all, of the required types of cover and had to support the resident quail population over winter with a negligible loss from all sources.

The Cook's Creek Bend covey range fulfilled these requirements

and is described as a typical example of a "good" to "excellent" covey range.

This covey range consisted of approximately 91 acres (fig. 7) on the Helser Cook property 2.2 miles north of the town of Sylvan along highway No. 456 and lies in an area known as "Little Cove". "Little Cove" is a valley which is about one mile wide at this point. To the west lies Tuscarora Mountain of about 2,000 feet elevation, while on the east is Cove Mountain which rises to 1,800 feet. This site was well sheltered from cold winds, although the shadowing effects of the mountains caused the snow to remain unusually long. The range was particularly interesting because of the fact that Helser Cook owned several hundred acres in one block on which he never allowed any quail to be shot. No birds had ever been released in this valley from game farm stock. The quail in Little Cove were referred to by the natives as the "old native" or "yellow quail".

While the soils are fairly deep their gravelly nature (Holston sandy loam and Amberson gravelly loam) limit their productiveness and, unless frequent applications of manure and fertilizer are made, the land soon becomes submarginal. Along Little Cove Creek, at the bottom of the valley, is found a compact subsoil phase of the Dekalb stony loam. This is acidic and supports a very raw humus. However, a rather good forest of sprouts and saplings is found here. This type of soil supports agriculture only on the best areas; hence numerous fields of waste land are found. Light thunder showers originate in this valley during spring and summer, but the porosity of the soils allows rapid drainage and prevents, to a certain extent,

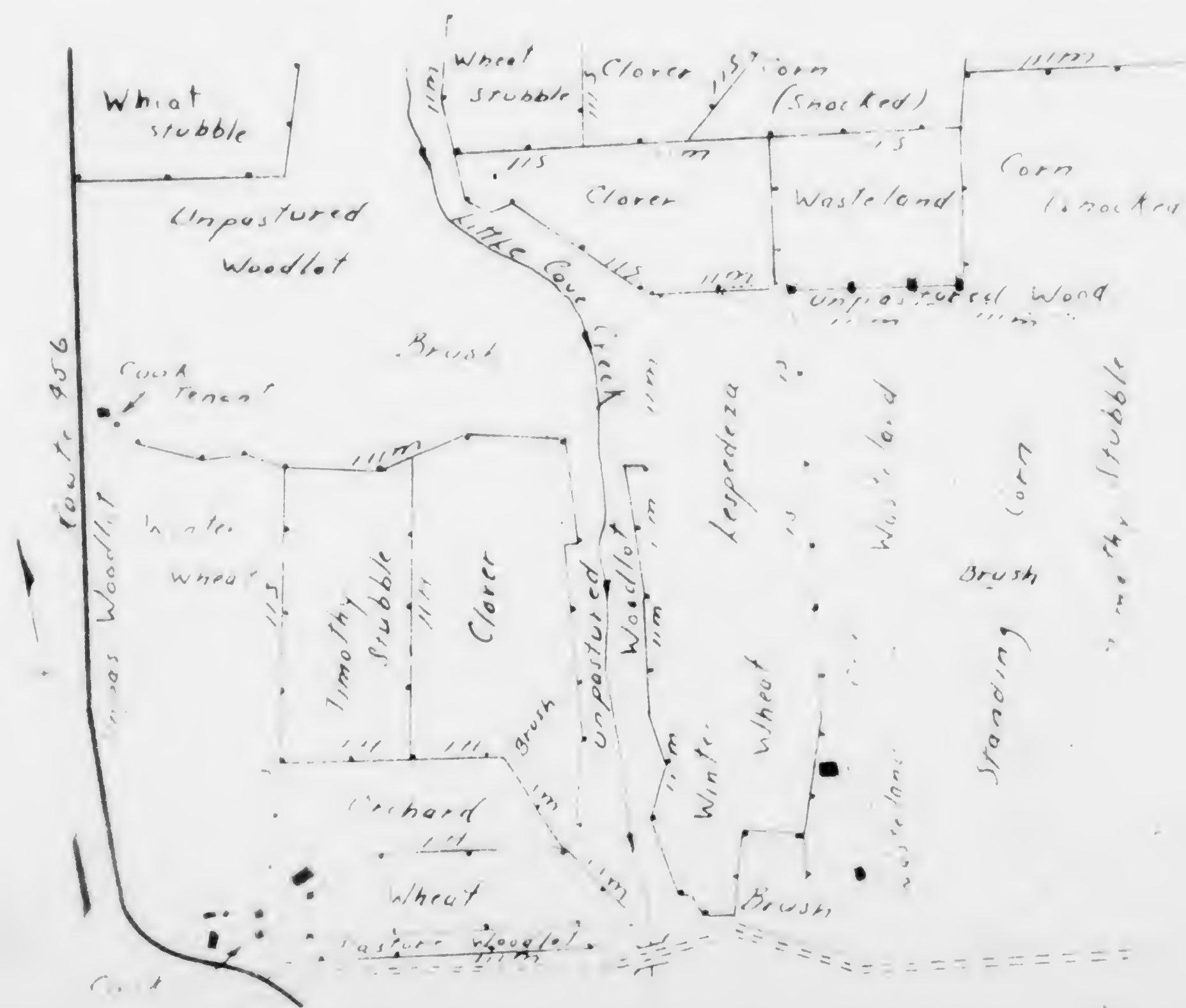
FIGURE 7
COVER MAP
OF
THE COOK'S CREEKBEND COVEY RANGE

SCALE 1" = 660'

OCTOBER 1940

LEGEND

FENCE ROWS	ROADS
H = Herbaceous plants	Macadam —————
S = Shrubs only	Gravel =====
m = Trees & Shrubs	Woven Wire Fence —•••••
I = Light Density	Rail Fence —•••••
II = Medium Density	Field Boundary
III = Very Dense	Stream —————
Buildings ■ ■ ■	Intermittent Stream ————



the accumulation of large puddles. Generally speaking, a good diffusion of cover types was present which should support resident quail populations through severe winters. Table 1, shows the land use for the Cook's Creek Bend covey range during the fall and winter of 1940-41.

Table 1.

LAND USE FOR THE COOK'S CREEK BEND COVEY RANGE

Fall and Winter 1940-41

Cover Type	Total acreage of each type	Percent of total	No. of times each type occurred
Idle fields	13	14	3
Timothy stubble	9	10	1
Korean lespedeza	10	11	1
Corn (shocked)	6	7	1
Corn (standing)	10	11	1
Woodland (young stand)	9	10	2
Woodland (old stand)	5	5	1
Red clover (unpastured)	7	8	1
Red clover (pastured)	5	5	1
Wheat stubble	4	4	1
Winter wheat	6	7	1
Brushland	5	5	2
Alfalfa	1	1	1
Old orchard	1	1	1
TOTAL	91	99	18

Idle Fields: These were areas that had not been cultivated for at least one year. They were covered with a dense vegetative growth (250 to 400 stems per square yard) from 12 to 18 inches in height. No grazing was permitted and this protection added materially to the availability of food and shelter. Asters (Aster spp.), golden-rods (Solidago spp.), wild carrot (Daucus carota), pigweed (Chenopodium album), foxtail, lesser ragweed (Ambrosia artemisiifolia), and smartweed (Polygonum pennsylvanicum) formed about 90 percent of the ground cover with 10 percent wild grasses. Smartweed was abundant on the more moist sites and sometimes formed 30 percent of the vegetation. The small waste area in the corner of the southwest clover field was on a poorly drained site covering approximately one acre. All waste areas were located close to more dense woody cover. Weed seeds were numerous and quail often used such areas for feeding grounds during late fall and winter (fig. 8). Roosts were numerous in the waste areas during late fall and winter.

Timothy Stubble: On this range timothy stubble did not provide very good food and cover during the critical period. It was mowed late and hence did not grow high enough to avoid becoming snow bound. Weed growth in this field was very light.

Lespedeza: A 10 acre patch of lespedeza lies adjacent to the strip of young woodland along the Little Cove Creek. Seed production was very heavy, and this patch provided feed for the birds until it became snow bound in late January. Red clover and alsike clover



**Fig. 8. Weed fields adjacent to dense brushy cover
provided good feeding and roosting areas
throughout the fall and winter.**



Fig. 8. Weed fields adjacent to dense brushy cover provided good feeding and roosting areas throughout the fall and winter.

(Trifolium hybridum), foxtail, and lesser ragweed were present in addition to the dense growth of lespedeza. The stems averaged 10 inches in height.

Corn: About two thirds of the corn remained standing throughout the winter after the ears had been picked by hand from the standing stalks. The remaining acreage of corn had been shocked and winter wheat planted in the available rows. Some of these shocks remained standing all winter, others were removed to be cut for ensilage. Both corn fields occurred adjacent to both woody cover and dense weed fields.

Woodland: Along the Little Cove Creek and bordering a small intermittent stream over the west slope of Cove Mountain were two patches of woodland that were composed of 80 percent sprout growth. These sprouts were from 20 to 25 years old and six to eight inches D.B.H. Sycamore (Platanus occidentalis), red maple, red mulberry (Morus rubra), shellbark hickory (Hicoria ovata), ironwood (Ostrya virginiana), crack willow (Salix fragilis), black walnut, yellow poplar (Liriodendron tulipifera), green ash (Fraxinus pennsylvanica var. lanceolata), white oak and hackberry (Celtis occidentalis) formed a mixed stand. The canopy was thin and allowed a dense understory of black haw (Viburnum prunifolium), raspberry, hawthorn (Crataegus spp.), giant ragweed (Ambrosia trifida), pokeberry (Phytolacca decandra), burdock (Articum minus), and honeysuckle to thrive.

Bordering the upper banks of the Little Cove Creek the woodland was a typical red oak, basswood, white ash, forest type. Old, dense, second-growth conditions prohibited any growth of desirable food and

shelter plants. The average age of the upper story was from 100 to 170 years and from 14 to 17 inches D.B.H., while the lower story was 30 to 50 years old and 9 to 12 inches D.B.H. Scattered white pines (Pinus strobus), black cherry, white oak and shellbark hickory were also found in this stand.

Clover: There was one seven-acre field of red clover, alsike clover, sweet clover, timothy, foxtail, and lesser ragweed. This vegetation had been allowed to grow to a height of 12 to 16 inches and remained until spring when it was plowed under. This field was adjacent to both woody cover and a dense weed field. The other clover field west of the Little Cove Creek had been heavily pastured and afforded no cover during the winter months.

Wheat: No wheat stubble was grazed on this farm and these fields supported a dense growth of lesser ragweed and foxtail. The vegetation averaged 10 to 14 inches in height. Woody cover was adjacent to this source of food in the form of medium to dense fence rows.

Brushland: These areas were wastelands densely covered with thickets of blackberry, raspberry, sumac, honeysuckle, greater ragweed, black locust, red alder (Alnus rugosa), and elderberry (Sambucus canadensis) together with a lower growth of poverty grass (Arista dichotoma) and sedges. About 50 percent of these areas were impassable for man and afforded excellent retreat cover. In the more open areas scrub pine (Pinus virginiana), and eastern red cedar (Juniperus virginiana) had come in owing to the natural plant succession from the old field type.

Old Orchard: One small orchard had been allowed to go "wild". Absence of cultivation had permitted a dense growth of orchard grass (Dactylis glomerata), blackberry and saw briar (Smilax glauca) to come in.

Fence Rows: All of the fence rows on this covey range contained essentially the same species. Trees found in the hedgerows were black walnut, shellbark hickory, black cherry, black locust and red maple. Lower vegetation included, in order of importance, blackberry, sumac, wild grape (Vitis sp.), giant ragweed, milkweed (Asclepias syriaca), black haw, poison ivy (Rhus toxicodendron), Virginia creeper (Pedera quinquefolia), bittersweet (Celastrus scandens), pigweed, burdock, wild roses (Rosa spp.), and carrion flower (Smilax herbacea).

Fences totaled 6,510 feet and were constructed mostly of smooth wire. Table 2, shows the composition and density of the fence rows on the Cook's Creek Bend range.

Table 2.

COMPOSITION AND DENSITY OF FENCE ROWS ON THE COOK'S CREEK BEND RANGE

Classification :	Composition			
	No vegetation	Shrubs only	Trees and shrubs	Total
I	250 feet	1,150 feet		1,400 feet
	or 4 percent	or 20 percent		or 24 percent
II		1,000 feet	660 feet	1,660 feet
		or 17 percent	or 10 percent	or 27 percent
III		650 feet	2,800 feet	3,400 feet
		or 9 percent	or 40 percent	or 49 percent
Total	250 feet	2,800 feet	3,460 feet	6,510 feet
	or 4 percent	or 46 percent	or 50 percent	or 100 percent

Over-winter History of Quail on a Typical Good to Excellent Covey Range

On September 20, 1940, one male and three female quail were observed in the orchard to the east of the Cook barn. These, together with other small groups of quail had been observed close to the farm buildings by different members of the Cook family throughout the preceding summer. They spent most of their time in the orchard and near the woodlot along the creek.

On the same date four adults of unknown sex and four young birds from three to four months old were observed in the high brush area at the bend of Little Cove Creek northeast of the Cook buildings. Mr. Cook reported that during the past five winters numerous small groups of quail assembled in early fall and ranged through this dense brush at the creek bend, often moving east along the intermittent stream and west to Route 456.

Throughout September and the first week of October it was possible to flush scattered groups of four to six quail over most of the range. These birds were often flushed from the centers of large clover, lespedeza, or fallow fields. When the vegetation became less dense in mid-October, the birds assembled and were joined by five others from the surrounding territory to form two groups of 10 and 13 birds each (Coveys A and B). These groups remained more or less separated until late January. The covey of 10 (Covey A) spent most of its time near the brush west of the bend in Little Cove Creek. They were observed several times a week, either by one of the investigators or by members of the Cook family. At no time were they seen to be far from the dense brush area. From two to three hours after sunrise it was often

possible to see the birds feeding in the timothy and clover fields south of the brush area, and one morning they were observed dusting near the fence row that separates the timothy stubble and clover field.

The covey of 13 birds (Covey B) confined its activity to the fields adjacent to the intermittent stream that flows into the Little Cove Creek. In the early morning the covey fed in the lespedeza field and later moved into the weed field north of the stream or into the woody vegetation along the stream to spend the rest of the day. Late afternoons were usually spent in the lespedeza or clover fields.

It was not always possible to observe exactly the same number of birds each day. The number of each of these coveys varied from 9 to 15; however, no indication of a union of the two coveys was apparent.

During both winters, a program of quail trapping was carried out in conjunction with another study to determine the relative values of wild-trapped and game farm quail for restocking purposes. A trap had been set in the weed field northeast of the lespedeza patch since mid-December but was ignored by the quail until January 15, on which date nine birds were flushed within 10 feet of the trap. There was at that time a one-half inch layer of snow on the ground, and chaff on the surface indicated that this particular group of quail had been feeding on both aster and lespedeza seeds.

On January 24, twenty-two quail were flushed from around the trap in the weed field. The observer was able to count at least 22 before they flew out of sight, and it was probable that there were several more. They all flew west in one group and alighted in the brush patch. There was one-half inch of snow and sleet on the ground at the time,

and some of the bait outside the trap had been eaten. A roosting place of 20 or more birds was found in the edge of the lespedeza field.

On January 30, two traps, about 50 yards apart, were placed in the brush area. Both were set in the edges of the dense patches of blackberry briars. On January 31, fourteen quail were in one of the traps. They had apparently discovered the bait the previous evening while moving to roost and had entered the trap at that time. This group consisted of six females and eight males, all in very good condition and weighing 5.0 to 6.4 ounces.

The remaining 9 or 10 birds were later observed in the brush area; but repeated attempts to trap them failed. It is believed the large amount of natural food available was the chief factor in preventing their capture.

No birds disappeared from this covey during the winter and no evidence of predation was found. It was reported by different members of the Cook family that loss of birds from coveys that inhabit the Creekbend range is a rare occurrence and that the birds usually survive all winters, including the severe winter of 1935-'36.

On April 11, 1941, 16 wild trapped birds were released in the Creekbend brush patch. They scattered immediately and whistling began three weeks later.

On May 25, a pair was noted in the fence row along the intermittent stream, and on June 17, 15 eggs were hatched from a nest in the northern edge of the lespedeza field 75 yards east of the creekbend. Other nests might have been located on this range, but were not encountered by the investigators.

The covey range during the winter of 1941-'42 was essentially the same as the previous winter with the exception of the following changes. The clover field northeast of the creekbend was a shocked corn field. The corn field in the northeast corner of the range was in winter wheat and the acreage in standing corn was reduced to 6 acres.

Two coveys were located with the aid of a bird dog in early September; one, containing 12 birds, was found in the weed field northeast of the creekbend. The second group of 18 quail was flushed from the fence row along the east edge of the lespedeza field approximately 400 yards from the first covey. Throughout the winter these two coveys often united and their identification became impossible. One bird was killed by a cat in early January, but this was the only evidence of predation or loss during the winter of 1941-'42. In the early spring of 1942 the entire covey of 29 quail spent most of the time between the large brush area and the 10 acre lespedeza field.

Analysis of Good to Excellent Quail Range

The average size of the 12 bob-white ranges in this classification was 83 acres and most were found on the poorer soil types. Although a few good ranges were found on the more productive soils; most of them occurred on areas where rocky soils or soils of low fertility prohibited intensive farming on all but the best lands. On such ranges numerous waste areas, brush patches, and wide dense fence rows were common.

Within Franklin County climatic conditions did not have any effect on the classification of covey ranges. There were as many good ranges

in the northern and colder part of the county as there were in the southern portion.

Twenty different types of cover occurred on the 12 good to excellent bob-white ranges. The number of ranges on which each of these types occurred, together with the average acreage of each on each of the 12 ranges, the average percent of the total area of each range, and the average number of times that each cover type occurred on each of the ranges is shown in Table 3.

Table 3.

AN ANALYSIS OF THE COVER TYPES FOUND ON TWELVE GOOD TO EXCELLENT
COVEY RANGES

Cover Type	No. of ranges on which the cover type occurred	Percent of total No. of ranges	Average acreage on each range	Average percent of total area of each range	Average frequency of occurrence on each range
Brushland	8	64	7	5	2
Wheat stubble	7	56	31	19	5
Old woodland	7	56	11	8	2
Corn (shocked)	7	56	18	12	2
Wasteland	6	50	29	23	5
Timothy stubble	5	42	9	8	1
Corn (standing)	5	42	9	8	2
Sweet clover	5	42	32	23	3
Orchard	4	32	2	2	1
Alfalfa	4	32	7	5	1
Young woodland	3	25	9	10	2
Red clover (Unpastured)	3	25	7	8	1
Tomatoes	3	25	4	3	2
Grassland	2	16	12	9	1
Winter wheat	2	16	6	7	1
Lespedeza	1	8	10	11	1
Red clover (Pastured)	1	8	5	5	1
Old orchard	1	8	1	1	1
Soy beans	1	8	3	2	1
Woodland (Fas.)	1	8	4	1	1

Brushland: Usually two patches of dense brush occurred on each range of this classification. Throughout the fall, winter and early spring the coveys spent a large part of their time loafing in these areas particularly if a stubble or weed field were close by to furnish a supply of grain or weed seeds. Black locust, sumac, elderberry, blackberry, raspberry (fig. 9), honeysuckle, burdock, greater ragweed, alder, eastern red cedar, grasses, and sedges were the most important species present.

Wasteland: Abandoned fields that supported a dense growth of smartweed, lesser ragweed, foxtail, pigweed, goldenrod, wild carrot, milkweed, asters and grasses provided an important source of food for quail during the fall and winter. This vegetation averaged two to three feet in height and 250 to 400 stems per square yard. Five of such areas were usually present and all were unpastured or lightly pastured.

Woodland: Both young and old woodland were present although not on every range. Only one range contained any pastured woodland and this formed but one percent of the total area of that range. In the young woodland, which averaged 6 inches to 8 inches D.B.H. and up to 25 years of age, reproduction and ground cover was abundant. In old woodlots, averaging 14 to 24 inches D.B.H. and 100 to 170 years of age, dense areas of brush and weedy cover often occurred under openings in the canopy.

Fence rows: A large part of the fence rows on good to excellent



**Fig. 9. Dense blackberry and raspberry thickets
were used in winter as escape and loafing
cover.**



Fig. 9. Dense blackberry and raspberry thickets
were used in winter as escape and loafing
cover.

ranges were composed of plants that provided both food and retreat cover for quail throughout the winter. Blackberry, raspberry, Japanese honeysuckle and wild grape were important plants found in fencerows. It was usually found that unless one or all of these plants were abundant, a range could not be classified as good to excellent. Japanese honeysuckle provided the most ideal retreat cover on all ranges (fig. 10).

Table 4 shows the average composition and density of the fence rows on good to excellent covey ranges.

Table 4.

AVERAGE COMPOSITION AND DENSITY OF FENCE ROWS ON TWELVE
GOOD TO EXCELLENT COVEY RANGES

Density	Composition			Total
	Very little or no vegetation	Shrubs only	Trees and shrubs	
I	175 feet or 2 percent	980 feet or 12 percent	1,100 feet or 14 percent	2,255 feet or 28 percent
II		580 feet or 7 percent	1,005 feet or 13 percent	1,585 feet or 20 percent
III		1,210 feet or 15 percent	2,900 feet or 37 percent	4,110 feet or 52 percent
Total	175 feet or 2 percent	2,770 feet or 34 percent	5,005 feet or 64 percent	7,950 feet or 100 percent

Cultivated Lands: All ranges contained at least two fields in either standing or shocked corn. Five ranges had standing corn fields (fig. 11) while eight ranges had fields of shocked corn. In some corn shocks



Fig. 10. Japanese honeysuckle in hedgerows and woodlots provided the most ideal shelter during periods of deep snow.



Fig. 10. Japanese honeysuckle in hedgerows and woodlots provided the most ideal shelter during periods of deep snow.



Fig. 11. Standing corn adjacent to woody coverts provided ideal feeding areas for quail during periods of deep snow.



Fig. 11. Standing corn adjacent to woody coverts provided ideal feeding areas for quail during periods of deep snow.

defective ears remained on the stalks.

Wheat stubble was unpastured on these ranges and a dense growth of lesser ragweed (fig. 12) and foxtail usually attained a height of from 10 to 14 inches. These species were also found in unpastured timothy stubble fields but were never as abundant as on wheat stubble fields. On two ranges wheat stubble fields were heavily manured when the last snow of the season was still on the ground and quail often were seen feeding in such places.

On three ranges red and alsike clover fields were unpastured and attained a height of from 12 to 16 inches by early fall. Lespedeza occurred on one range and although lightly grazed attained a height of from 10 to 15 inches. Sweet clover occurred on 5 ranges and attained a height of from 2 to 3 feet. Wet snows, however, weighted this vegetation down to a point where its value as cover was greatly reduced.

The third crop of alfalfa was left uncut on three of the four ranges on which this crop occurred. This permitted the vegetation to reach a height of 7 to 9 inches which was sufficient to provide good roosting cover throughout the fall and early winter.

Tomato and soybean fields were frequented by quail during the fall but during the winter no apparent use of them was made.

Orchards occurred on five ranges and averaged two acres on each range. In three orchards the twigs and branches that were pruned from the trees were piled in rows and the resulting brush piles (fig. 13) were often frequented by quail or used for roosting cover during periods when snow covered the ground. Dusting areas were abundant in orchards throughout the fall and winter.



Fig. 12. In unpastured stubble fields lesser ragweed provided a large source of winter food during all but the deepest snows.



Fig. 12. In unpastured stubble fields lesser ragweed provided a large source of winter food during all but the deepest snows.



Fig. 13 Brush piles in orchards were used during the winter as roosting places and escape cover in a number of cases.



Fig. 13 Brush piles in orchards were used during the winter as roosting places and escape cover in a number of cases.

Description of a Typical Marginal to Good Covey Range

Eighteen of the 53, or 34 percent, of the bob-white ranges that were studied were classified as "good" to "marginal". This classification indicated that on such ranges moderate winter and nesting season losses were sustained, however, the carrying capacity of the land was such as to prevent excessive losses at all seasons of the year. The Picnic Woods covey range was typical of all covey ranges in this classification.

Approximately 84 acres of land (fig. 14) are included in the range of this covey. The covey derives its name from a woodland park included in the range. Local residents refer to the park as the "Picnic Woods". It is located six-tenths of a mile west of Spring Run, Pennsylvania, on Route 433 in Path Valley.

The soil, Hagerstown clay loam, is difficult to cultivate because of its shallow nature, the presence of exposed bedrock, and its heavy clay-like structure. Timothy and alfalfa grow well, however, it is possible to obtain good crops of corn and wheat only in the most favorable years when the soil is neither too dry nor too wet. The land is flat to gently rolling, and, therefore, is not subject to an appreciable amount of sheet or gully erosion.

Temperatures are slightly lower during the fall, winter, and spring than in the Cumberland Valley, and the snow cover remains four or five days longer.

Hunting pressure had been very light for the past 10 years. Previous to 1930, however, this area was a favorite hunting ground for quail hunters. Numerous releases of game farm quail were made and

FIGURE 14

COVER MAP

OF

THE PICNIC WOODS COVEY RANGE

SCALE 1" = 660'

DECEMBER 1940

LEGEND

FENCEROWS:

- S = Shrubs only
 M = Trees & Shrubs
 T = Trees only
 I = Light Density
 II = Medium Density
 III = Very Dense

ROADS

- Macadam —————
 Gravel =====

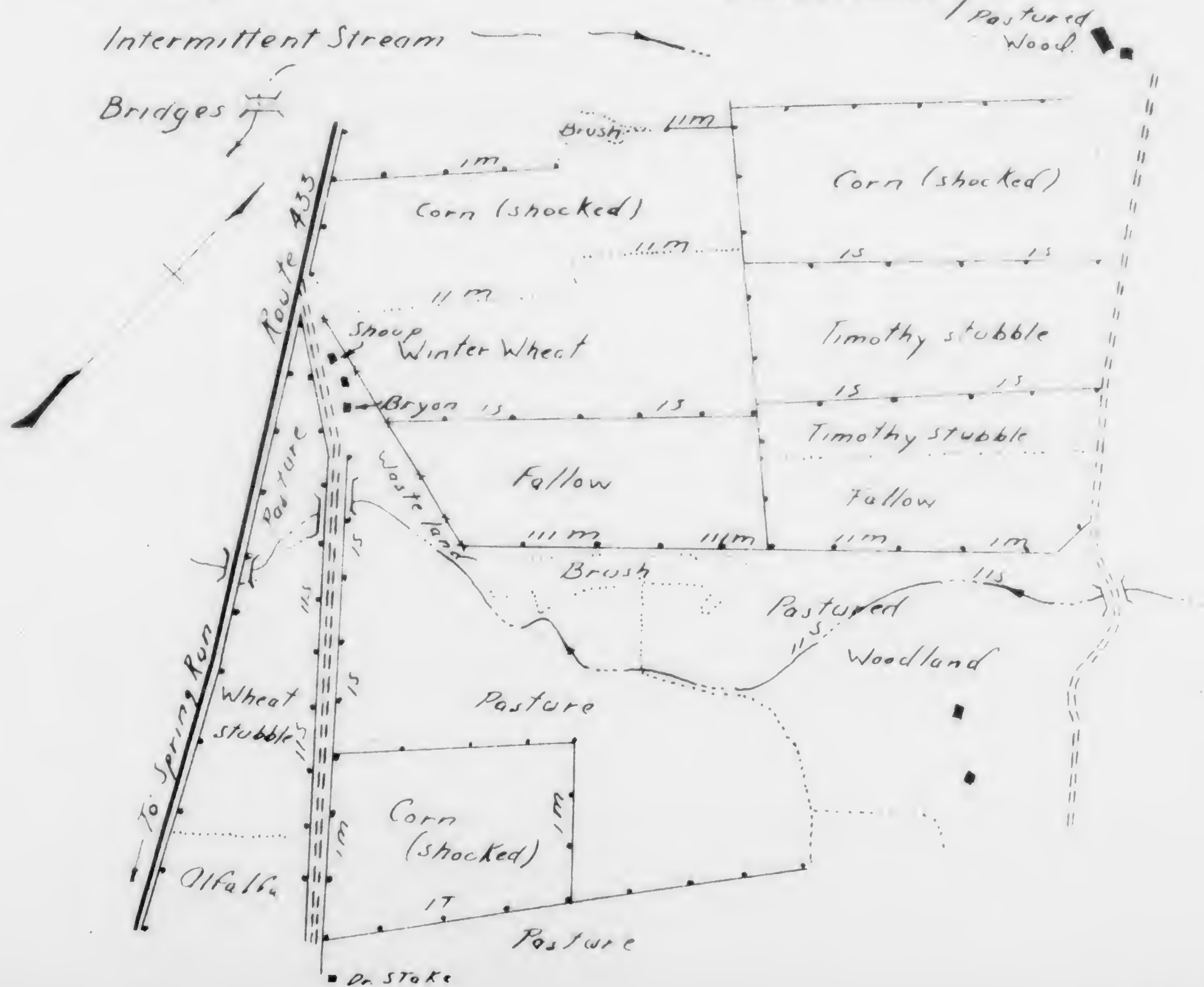
FENCES

- Barbed Wire * * * * *
 Woven Wire

Field Boundary

Intermittent Stream

Bridges



numerous hawks and owls were shot by sportsmen and farmers. House cats were numerous, and their tracks were found in all parts of the range during the winter.

Generally speaking the feeding areas and the cover on this range were not in the best relation to each other to provide the ideal environment for quail.

Table 5, shows the land use during the fall and winter of 1940-41.

Table 5

LAND USE FOR THE PICNIC WOODS COVEY RANGE

Fall and Winter 1940-41

Cover Type	Total acreage of each type	Percent of total	No. of times each type occurred
Pasture	17	20	2
Fallow fields	17	20	2
Winter wheat	13	16	1
Timothy stubble	9	11	2
Wheat stubble	7	8	1
Woodland (pastured)	7	8	1
Corn (shocked)	5	6	1
Alfalfa stubble	4	5	1
Brushland	2	2	1
Miscellaneous	3	4	-
TOTAL	84	100	12

Pasture: These fields of Kentucky blue grass had not been pastured for two years, however, weed growth had not as yet progressed to any extent. Scattered hawthorn trees were present, and the grass averaged

seven inches in height. Throughout the fall and early winter dusting areas were numerous in these fields.

Fallow Land: The two fallow fields were planted to sweet clover in the spring of 1941.

Wheat and Timothy Stubble: A dense growth of weeds, of which lesser ragweed was the most important, had come into these areas. During early fall young quail were observed on numerous occasions feeding on grasshoppers (Locustidae) and other insects in the stubble fields. During late fall and winter the chaff from weed seeds and droppings on the snow indicated that these fields were used as feeding areas by the quail. No woody cover except that found in the fence rows and a small patch of brush covering a limestone outcropping was found adjacent to these feeding areas.

Woodland: Cattle were permitted to graze in the woodland park; however, this has not materially injured the dense thickets of blackberry, bitter-sweet, poison ivy, and grape that were found along the west edge of the woodlot. Along the banks of the intermittent stream, within the park, a dense growth of blackberry and green briar had survived periodic flooding and forms a long travel lane of fair cover.

Alfalfa: The alfalfa field was lightly grazed during the summer of 1940 and the vegetation attained a height of 10 inches before winter. During the fall, quail were frequently observed in this field by Dr. Stake of Spring Run.

Brushland: The two-acre patch of brush that was nearly surrounded by woodland provided cover for the quail during severe weather. It was composed of black locust and blackberry and averaged four feet in height and attained a density of from 150 to 250 stems per square yard.

Fence Rows: The fence row that bordered the west edge of the woodland consisted mainly of blackberry, bittersweet, poison ivy, grape, a few scattered wild black cherry saplings and hawthorn bushes. Other hedges were less woody and contained poison ivy, bittersweet, green briar, asters, goldenrod, and grasses. Table 6 shows the composition and density of the fence rows.

Table 6.

COMPOSITION AND DENSITY OF FENCE ROWS ON THE PICNIC WOODS COVER RANGE

	Composition		Total
	Density : Shrubs only	Trees and shrubs :	
I	2,805 feet or 40 percent		2,805 feet or 40 percent
II	1,155 feet or 16 percent	1,815 feet or 26 percent	2,970 feet or 42 percent
III		1,190 feet or 18 percent	1,190 feet or 18 percent
Total	3,960 feet or 56 percent	3,005 feet or 44 percent	6,965 feet or 100 percent

Over-winter History of Quail on a Typical Marginal to Good Covey Range

On September 24, two adult quail with 25 young were flushed from the center of the corn field northeast of Route 433. When flushed they separated into two groups. An adult male with eight young formed one group, while an adult female with 17 young formed the other. The group of nine remained on the north side of the highway, and the larger group flew south across the highway and formed a second covey on a new range. The young birds were approximately six weeks old at the time; but no residents of the vicinity could supply information as to where they were hatched.

This group of 27 quail were never observed together again during the course of the observations. During September and October a covey of nine quail remained within 300 yards of the brush area at the southwestern tip of the park. Droppings and dust baths were seen in the stream bed, and on one occasion two birds were seen perched 10 feet above the ground in a wild black cherry tree, while the rest of the covey remained motionless in the brush at the base of the tree.

Two birds were reported shot during the first week of hunting season, and Mr. Bryon reported seeing a cat cross the highway west of his house with a quail in its mouth. The cat escaped before he could catch it.

Contact with the covey was lost until January 7. At that time five quail were seen scratching in the oak leaves under a 24-inch oak log in the southern corner of the Picnic Woods. The log was surrounded with blackberry briars, and the leaves had been disturbed

over an area of approximately 10 square yards. From early December to mid-February the ground was often covered with six to eight inches of snow. As the snow cover diminished, the birds extended their range to the bridge 150 yards southwest of the brush area and often came within 50 feet of the Bryon home. By the end of March the birds had shifted their range slightly and were observed in the woodland edge adjacent to the plowed land.

The covey was composed of 9 birds at the beginning of the winter. Two birds were shot during hunting season, one was killed by a cat and a fourth was lost in an unexplained manner. These losses represent 44 percent of the total fall population. However, only 22 percent of these losses were natural losses and 22 percent was from hunting.

Nothing was seen of the remaining 5 birds during the spring; however, in the latter part of July two broods of young quail were discovered on this range. One group consisted of 6 young with an adult pair that ranged throughout the large brush area and woodland edge. The second brood was made up of 7 young and an adult male and spent most of the time between Route 433 and the gravel road that joins it at the Shoup residence.

The first brood lost 2 birds in August and was joined by the second in late September.

During the fall and winter of 1941-42 the wheat stubble field and alfalfa adjacent to the highway remained as in 1940-41. The winter wheat field also was a wheat stubble field. The corn field at the western edge of the range had been sown to rye and the fallow

field had been seeded to corn which was cut in September and removed for ensilage.

Two quail disappeared in late September. It was found that a Sharp-Shinned Hawk (Accipiter velox velox) had taken one but the investigators were unable to account for the other missing bird. No birds were shot during hunting season.

During the mild winter of 1941-42 the 12 birds ranged over all of the covey range but were located most frequently around the brush areas near the Picnic Woods. One bird was missing when the covey was last seen in mid-March.

Five birds or 28 percent of the total population were lost during the second year of the investigation.

Analysis of Marginal to Good Quail Range

The average size of the 18 bob-white ranges in this classification was 72 acres. Twelve ranges were found on the better soil types, three occurred on land of fair productivity while the remaining three were found on poor land. Generally speaking the land is more intensely farmed on the good to marginal ranges than on the good to excellent ones (figs. 15 and 16).

The vegetation on this type of range differed from that on the best ranges quantitatively rather than qualitatively. With few exceptions the same species were found on all classes of quail range but on the poorer ranges cover was less dense, food supplies were not as abundant and the dispersion of all type of cover was poorer.

An analysis of the cover types that were found on the ranges of medium quality is shown in Table 7.



Fig. 15. The Reilly Covey Range at Quincy (a "marginal to good" range) in summer. The land was more intensively farmed than on the best ranges.



Fig. 15. The Reilly Covey Range at Quincy (a "marginal to good" range) in summer. The land was more intensively farmed than on the best ranges.



Fig. 16. The Reilly Covey Range after a 2-inch snowfall.



Fig. 16. The Reilly Covey Range after a 2-inch snowfall.

Table 7.

AN ANALYSIS OF THE COVER TYPES FOUND ON EIGHTEEN MARGINAL TO GOOD
COVEY RANGES

Cover Type	No. of ranges on which the cover type occurred	Percent of total No. of ranges	Average acreage on each range	Average percent of total area of each range	Average frequency of occurrence on each range
Timothy stubble	15	83	11	17	1
Wasteland	14	77	14	22	3
Corn (shocked)	11	61	8	13	1
Grassland	9	50	6	11	1
Alfalfa	8	44	15	16	1
Woodland (Unpastured)	4	22	8	11	1
Red clover (Pastured)	3	17	8	10	1
Wheat stubble	3	17	33	39	2
Orchard	3	17	30	45	2
Woodland (Pas.)	2	11	11	22	1
Corn (standing)	2	11	4	8	1
Winter wheat	2	11	8	13	2
Sweet clover	2	11	6	7	1
Fallow fields	2	11	4	6	1
Gardens	2	11	4	4	2

Wasteland: Although, on this type of range, brushland was noticeable by its absence, weed fields were found on 14 of a total of 18 ranges.

The species composition of these fields was essentially the same as on the better ranges, but vegetation was considerably less dense (average density was 125 to 200 stems per square yard). Grazing had reduced the value of many of these fields for quail food and shelter.

Woodland: Only 22 percent of the ranges contained unpastured woodland. Eleven percent of the ranges contained woodland that had been heavily pastured. Some of the unpastured woodlots had been pastured recently and although no grazing was permitted at the present time the lower vegetation had not recovered sufficiently to provide cover during the winter months.

Fence rows: A large percentage of the species that occurred in the fence rows on the best ranges were also found in these fence rows. Japanese honeysuckle, blackberry, raspberry, black locust and wild grape were not as abundant nor as frequently found.

The more dense fence rows did not form as high a percentage of the total length of fence rows on each range as they did on the best ranges.

Table 8 shows the average composition and density of the fence rows on the 18 good to marginal covey ranges.

Table 8.

AVERAGE COMPOSITION AND DENSITY OF FENCE ROWS ON EIGHTEEN
MARGINAL TO GOOD COVEY RANGES

: Composition :				
: Herbaceous :				
Density :	vegetation	Shrubs only	Trees and shrubs :	Total
I	1,152 feet or 13 percent	1,347 feet or 16 percent	1,650 feet or 19 percent	4,149 feet or 48 percent
II		990 feet or 12 percent	1,563 feet or 18 percent	2,553 feet or 30 percent
III			1,856 feet or 22 percent	1,856 feet or 22 percent
Total	1,152 feet or 13 percent	2,337 feet or 28 percent	4,074 feet or 59 percent	8,563 feet or 100 percent

Cultivated Land: Timothy stubble was found on 23 percent of the ranges and averaged 17 percent of each range on which it occurred. Although wheat stubble was found on 17 percent of the ranges, it formed 39 percent of the total area of the ranges on which it occurred. Both timothy and wheat stubble fields together with red clover were heavily pastured and weed growth in such fields was of much lower density than in unpastured stubble fields. Ragweed seldom reached a height of more than 6 inches. Three crops of alfalfa were removed during the summer and early fall.

Standing corn occurred on 11 percent of these ranges as against 42 percent on the best ranges. Eleven ranges (61 percent of the total number) contained shocked corn fields. In one of these fields,

defective cars had been allowed to remain on the stalks in the shocks.

Three ranges contained an average of 30 acres each in orchards.

Brush was not piled in these orchards in order to facilitate cultivation.

Description of a Typical Submarginal Covey Range

Twenty three of the 53 or 43 percent of the bob-white covey ranges were classified as submarginal. That is, they were unable to support the late summer or early fall population without excessive losses of all types. Food and cover were not available in the proper amount nor in the proper relation to each other and in some cases were not sufficient to carry the birds through two relatively mild winters without extremely high losses. The Cat's Prey Covey Range was chosen as a typical example of such a range.

Eighty-five acres of land are included in this range (fig. 17). The tract lies southwest of Route 433 one mile northwest of Spring Run, Pennsylvania. The covey derives its name from the fact that throughout the winter it was subject to constant predation by a house cat. Several attempts to shoot this animal failed, and the hostile attitude of several of the local residents prevented the setting of traps.

Previous to the winter of 1935-36 this portion of Path Valley was reported to have supported a very high quail population. Although the present population is far below that of seven years ago, a few birds are occasionally shot in this vicinity. Game farm birds are usually released here in the spring and fall, and on numerous occasions Mr. Harvey Rosenberry, Deputy Game Protector, has trapped quail from this

FIGURE 17

COVER MAP OF THE CAT'S PREY COVE Y RANGE

SCALE 1" = 660'

DECEMBER 1940

LEGEND

FENCEROWS

S - Shrubs only

M - Trees & Shrubs

I - Light Density

II - Medium Density

III - Very Dense

Buildings ■ ■ -

ROADS

Macadam —————

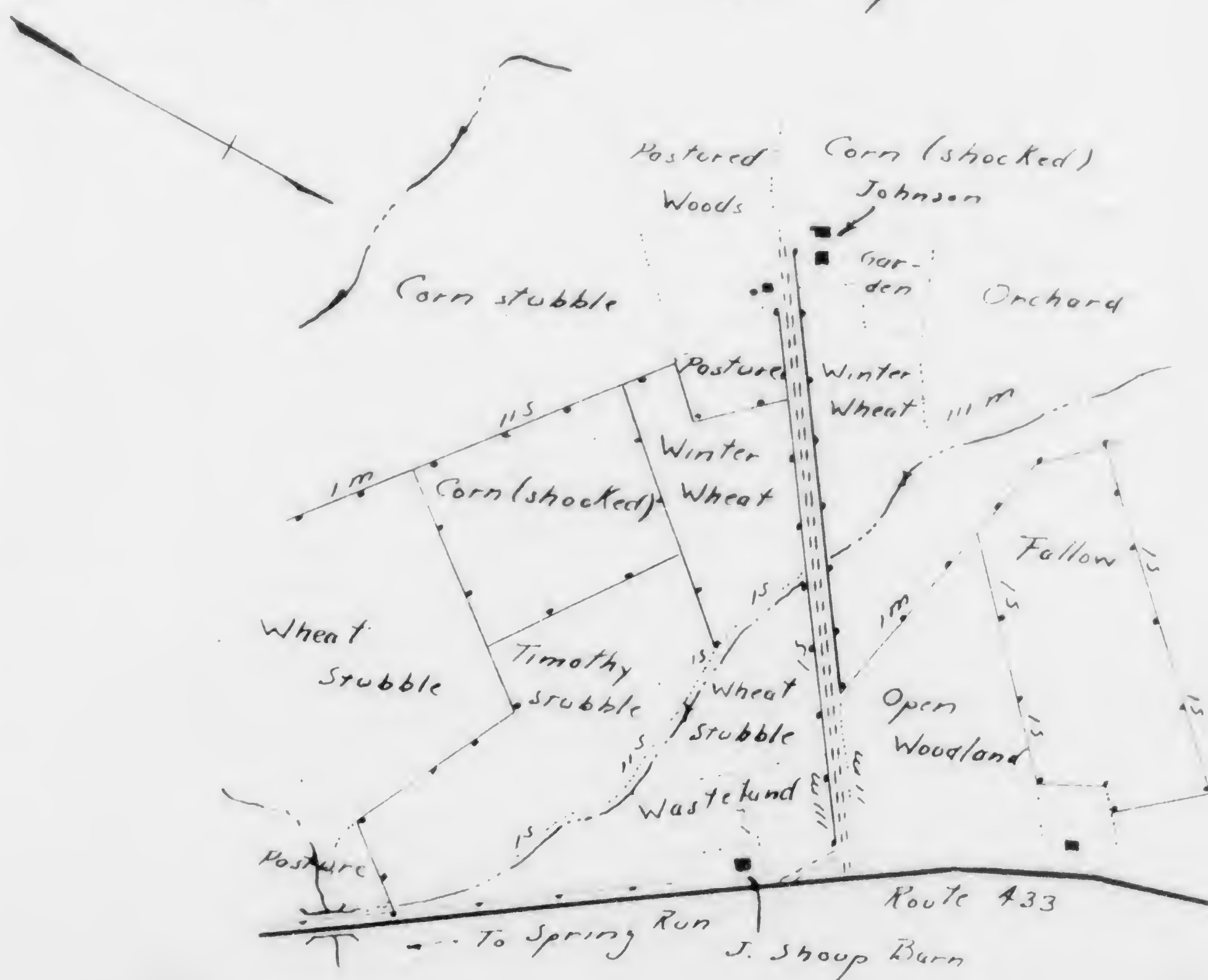
Gravel =====

Woven Wire Fence - - - - -

Field Boundary

Intermittent Stream

Bridge



area and held them in pens during the critical winter period.

The land is moderately rolling and produces fair crops of corn, wheat, timothy, and clover. The Buchanan gravelly loam is the dominant soil type, and the surface layer usually contains considerable quantities of rounded sandstone gravel and shale particles. Stone piles are numerous, but a lack of surrounding vegetation makes them useless as a source of food or cover. Table 9 shows the land use during the fall and winter of 1940-41.

Table 9.

LAND USE FOR THE CAT'S PREY COVEY RANGE

Fall and Winter 1940-41

Cover Type	Total acreage of each type	Percent of total	No. of times each type occurred
Corn (shocked)	20	24	2
Wheat stubble	17	20	2
Timothy stubble	13	15	1
Wheat	11	13	2
Woodland (unpastured)	11	13	2
Wasteland	7	8	1
Pasture	2	2	1
Miscellaneous	4	5	-
TOTAL	85	100	11

Corn: Both corn fields had been sown to winter wheat, and, therefore, no vegetation that would furnish a source of food during the winter months was present. No corn was left on the stalks in the shocks.

Stubble Fields: All the stubble fields on this range were pastured heavily until mid-October. The weed growth was very light and could not be used as a source of food during the periods when the snow was over four inches deep.

Woodland: Both patches of woodland had not been pastured for several years, but severe grazing had depleted the reproduction and ground cover to such an extent that it had not attained sufficient density to provide more than a fair amount of cover. Both woodlots were composed largely of mature and over-mature white and red oaks, shellbark hickories, and wild black cherry trees. Approximately 80 percent of the stand was over 15 inches D.B.H. and 65 feet in height. The remaining 20 percent consisted of red maple, green ash, tulip poplar, shad bush (Amelanchier canadensis), and black gum (Nyssa sylvatica).

Waste Land: The smaller field of waste land between the Shoup barn and the gravel road supported a much more dense vegetative growth than the larger field. In the smaller field aster, milkweed, burdock, blackberry, Japanese honeysuckle, carrion-flower, and grass attained a height of three feet and a density of 300 to 400 stems per square yard.

The larger field was formerly a timothy field that had been allowed to lie idle. Vegetation in this field consisted of a very light growth of grass, wild rose, and wild carrot. The drainage ditch south

of the Shoup barn was frequented by the covey of quail. Lesser ragweed, grasses, wild rose, and blackberry formed a light vegetative cover on both sides and bottom of the ditch.

Fence Rows: In fence rows where both trees and shrubs were present, wild black cherry, sassafras, white oak, and hackberry were the dominant trees. Shrubby growth consisted largely of poison ivy, blackberry, carrion-flower, and bittersweet. The herbaceous vegetation, when present, was largely grass and wild carrot. Table 10, shows the composition and density of the fence rows on the range of the Cat's Prey Covey.

Table 10.

COMPOSITION AND DENSITY OF FENCE ROWS ON THE CAT'S PREY COVEY RANGE

Density :	Composition		Total
	Shrubs only	Trees and shrubs :	
I	1,485 feet	660 feet	2,145 feet
	or	or	or
II	37 percent	17 percent	38 percent
	990 feet	495 feet	1,485 feet
III	or	or	or
	25 percent	13 percent	38 percent
Total		330 feet	330 feet
		or	or
Total	2,475 feet	1,485 feet	3,960 feet
	or	or	or
	62 percent	38 percent	100 percent

Over-winter History of Quail on a Typical Submarginal Covey Range

The Cat's Prey covey was first observed and reported to one of the investigators by Mr. H. W. Rosenberry on October 9, 1940. From that time to November 1, the group of 10 birds ranged east and west in the drainage ditch and southwest to the woodlot at the southwest edge of the range. Observations were easy to make because of the relative lack of cover, and it was a simple matter to locate the birds at will. During the two or three hours following sunrise and from an hour before sunset, the covey could be found either at the edge of the woodlot 120 yards southeast of the Johnson house or in the waste field between the Shoup barn and the gravel road. Roosts were often found in this waste field. In the middle of the day the covey ranged throughout the length of the drainage ditch.

On the first and second day of November, six of this covey were shot, and the remaining four were scattered so that contact with them was lost until November 21. At that time Mr. Rosenberry reported seeing 11 quail cross under the gravel road in the drainage ditch 400 yards southwest of the Shoup barn. On November 22, 15 quail were flushed from the drainage ditch 100 yards south of the Shoup barn. It was assumed that the additional 11 birds had been scattered from an adjacent range one-half mile to the south of the range of the Cat's Prey Covey. This assumption was substantiated by a report that a covey of 12 quail had disappeared from a farm one mile south of the Shoup barn. The investigators had never seen this latter covey, but the report was from a reliable source.

On November 28, a cat was seen stalking the covey in the drainage ditch south of the Shoup barn. The cat was frightened away but only 12 quail could be found. In mid-December nine birds were observed in the corner of the small brush field 60 yards southwest of the Shoup barn. No evidence of predation could be found; but cat tracks were numerous, and a small boy reported seeing the cat running into the barn carrying a quail in its mouth.

Contact with the covey was lost until mid-January, when tracks of approximately nine birds were seen crossing from the Shoup barn to the drainage ditch. There were about 1.5 inches of snow on the ground at the time, and a trap was set 60 yards southwest of the barn. On January 30 a roost of nine quail was found in six inches of snow in a brush pile 25 yards northwest of the trap, but the birds were not seen in the vicinity until February 4. At that time one female quail weighing 5.0 ounces was trapped, and on March 2, Mr. Johnson reported six quail in his yard feeding on scattered grains of corn. On April 1, Johnson reported several whistling cocks along the edge of the woodland south of his home.

Over-winter losses on this range were extremely high in spite of the fact that the weather and snow conditions were not severe. Of 21 quail that were found on the range at different times, 15, or 71 percent, were lost.

Two broods of young quail were discovered on this range. One group of 8 ranged near the Johnson farm building. The second brood of 6 occupied the territory close to the drainage ditch. In September

these two broods merged into one covey of 12 birds. Two of the original 14 were missing.

During the spring of 1941 the waste areas along Route 433 were seeded to corn which was removed in the fall as ensilage. Corn fields were seeded to winter wheat and wheat stubble was plowed and seeded to corn. The timothy stubble remained as such during the second winter.

No birds were known to have been shot during the hunting season of 1941, however, by December 20 only 10 of the original 12 could be found. This covey did not spend as much time near the drainage or did the covey of the preceding year, but rather confined the major part of its wanderings to the areas northwest of the gravel road. In February the entire covey of 8 birds was trapped in the woodlot close to the Johnson buildings.

A total of 6 birds were lost from this covey during the relatively short time that they were at large during the fall and winter months. This represented a loss of 44 percent of the original covey.

Analysis of Submarginal Quail Range

The average size of the 23 submarginal ranges that were studied was 74 acres. Eleven were found on lands of relatively high productivity, eight on fair lands, and four were found on areas whose productivity was below the average for the county.

Submarginal ranges were characterized by low quality and poorly distributed cover and feeding areas. The species of vegetation present was similar to that of the good to marginal ranges except that it occurred in a condition less suitable for quail. In many cases the

proper cover was lacking entirely or was insufficient to maintain the early fall population over-winter. An analysis of the cover type that occurred as submarginal quail ranges is shown in Table 11.

Table 11.

AN ANALYSIS OF THE COVER TYPES FOUND ON TWENTY THREE SUBMARGINAL
COVET RANGES

Cover Type	No. of ranges on which the cover type occurred	Percent of total No. of ranges	Average acreage on each range	Average percent of total area of each range	Average frequency of occurrence on each range
Grassland	17	74	10	13	2
Timothy stubble	15	65	17	27	2
Wheat stubble	11	48	10	13	1
Winter wheat	11	48	12	16	2
Corn (shocked)	11	48	5	6	1
Wasteland	11	48	12	20	1
Brushland	9	39	2	3	1
Woodland (Pas.)	9	39	8	11	2
Alfalfa stubble	9	39	9	10	1
Orchard	4	17	1	1	1
Pine plantation	2	9	2	4	1
Red clover (Pastured)	2	9	2	1	1
Fallow fields	2	9	2	1	1
Barley stubble	2	9	2	2	1

Wasteland: Although weed fields occurred on 48 percent of the ranges and brushland on 39 percent of the submarginal ranges, the distribution and density of these areas was such that their value to quail was negligible. Weed fields usually occurred in one solid block comprising 20 percent of the range. Four of the nine brush areas were pastured and were unsuitable for quail. The average density of the weed fields was 50 to 135 stems per square yard.

Woodlands: All woodlots, with the exception of 2-acre red pine (*Pinus resinosa*) plantation on one covey range, were pastured, or had been pastured recently. Cover was at a minimum in the woodlots but the pine plantation provided refuge for quail during both winters. These trees were 14 years old and from 4 to 9 feet high.

Cultivated Lands: Either late mowing or grazing by cattle or sheep had prevented the weed growth in the timothy stubble, red clover, barley stubble and wheat stubble fields from reaching sufficient height or density to provide much food for quail especially after a light snowfall. On five ranges, alfalfa reached a height of 8 inches and was heavily utilized as roosting cover during the fall and early winter.

No standing corn was found on any range and on six of the 11 ranges where corn was found, the shocks were removed in the fall to be used as ensilage.

Fence Rows: The absence of dense woody fence rows on these ranges was notable. Blue grass, asters, burdock, milkweed, carrion-flower,

poison ivy, goldenrod, greater ragweed, and wild rose were the most numerous herbaceous plants. Woody plants, when present, were the same as on the other class of ranges. Table 12 shows the average composition and density of the fence rows on 23 submarginal covey ranges.

Table 12

AVERAGE COMPOSITION AND DENSITY OF FENCE ROWS ON TWENTY THREE
SUBMARGINAL COVEY RANGES

: Composition :				
: Herbaceous :				
Density :	vegetation	Shrubs only	Trees and shrubs :	Total
I	1,336 feet or 30 percent	949 feet or 24 percent	729 feet or 18 percent	2,914 feet or 72 percent
II		426 feet or 11 percent	495 feet or 12 percent	921 feet or 23 percent
III		110 feet or 3 percent	70 feet or 3 percent	180 feet or 5 percent
Total	1,336 feet or 30 percent	1,485 feet or 38 percent	1,294 feet or 32 percent	4,015 feet or 100 percent

Game Farm and Wild Trapped Coveys and Covey Ranges

One hundred game farm quail were released in mid-April 1941.

Five pair were released at each place and all were marked with white tail feather markers to enable the investigators to identify them. At the same time 84 wild trapped quail were released. The wild trapped birds were placed mostly in the same coverts from which they were taken; however, some were released on the same ranges with the game farm quail. All wild trapped quail were marked with yellow tail feather markers.

The game farm quail displayed no tendency to seek cover when released. They left the shipping boxes slowly and took from two to ten minutes to conceal themselves. A few groups were frightened after release and flew short distances or perched in trees close by.

In contrast to the activity of the game farm birds, the wild trapped birds immediately flew to the nearest cover.

Game farm quail displayed a peculiar tendency to remain in the vicinity of dwellings or farm buildings for a period of from two to three weeks after release. One group of birds often came into a barnyard and one of its members was captured by hand in order to save it from a house cat. When many of the other groups were encountered in the field, they did not make a great effort to escape or conceal themselves. After three weeks, however, they learned to conceal themselves or take wing almost as well as the wild trapped birds.

The over-winter history and the utilization of cover by both game farm and wild trapped quail was similar to the wild birds. Any small

differences could be attributed to the element of chance in choosing the place of release and not to any different preferences on the part of the game farm or wild trapped quail.

Tables 13, 14, 15, and 16 show a summary of the breeding season and over-winter histories of the game farm and wild trapped quail on each class of range.

The game farm quail used in the study had been held over winter at the game farm by two different methods and the investigators were asked to note and report any differences in behavior in the two types of birds. Type A and Type B, as they were designated, showed little if any significant differences in actions when they were released and in cover utilized during all months of the year.

Table 17 shows a summary of the average increases and decreases in population from the spring of 1941 to the spring of 1942 for both game farm and wild trapped quail. Because of the mildness of the winter of 1941-42 the difference in survival on the three types of range was not as great as it might have been if the climatic conditions had been more severe.

Table 13

SUMMARY OF BREEDING SEASON HISTORY OF GAME FARM QUAIL

Classes of Covey Ranges	No. birds released Spring 1941		Early fall population 1941			Percent increase	
	Type A	Type B	No. of birds		Origin	Type A	Type B
			Type A	Type B			
Good to Excellent Cook's Lane Covey		10		18			80
Reilly Covey		10		25			150
Marginal to Good Foreman Covey *		10			39		95
Doyleburg Covey #	10		0				
Submarginal							
Miller Covey **	10				26		37
Knob Mt. Covey	10		16			60	
Eberly Covey	10		10			0	
Mill Race Covey	10		19			90	
Quincy Covey ##		10		22			120
Dogwood Copse Covey #		10		0			

* Ten wild trapped quail also released

** Nine wild trapped quail also released

Entire release disappeared

Wild trapped quail known to be present

Table 14.

SUMMARY OF OVER-WINTER HISTORY OF GAME FARM QUAIL

Classes of Covey Ranges	Fall population 1941			Spring population 1942			Percent decrease		
	No. of birds			No. of birds					
	Type A	Type B	Origin unknown	Type A	Type B	Origin unknown	Type A	Type B	Origin unknown
Good to Excellent									
Cook's Lane Covey	18			15	T			11	
Reilly Covey ***	25			21				16	
Marginal to Good									
Foreman Covey **			39			21 ##			46
Doylesburg Covey	0	0	0			3 X			
Submarginal									
Miller Covey			26			8 #			69
Knob Mt. Covey	16			10			37		
Eberly Covey *	10			6			40		
Mill Race Covey	19			11			42		
Quincy Covey		22			12			45	
Dogwood Copse Covey		0			0			0	
* One bird known shot				T One bird trapped		# Seven birds migrated			
** Three birds known shot				X Influx of three birds		## Twelve birds migrated			
*** Four birds known shot									

Table 15.
SUMMARY OF BREEDING SEASON HISTORY OF WILD TRAPPED QUAIL

Classes of Covey Ranges	Spring release 1941 No. of birds	Fall population 1941 No. of birds		Percent increase	
		Wild trapped	Origin unknown	Wild trapped	Origin unknown
Good to Excellent Cook's Covey	16	30		88	
Sime Covey	9	17		89	
Marginal to Good Foreman Covey *	10		39		95
Mahon Covey	10	39 #		130	
Cowan's Gap Covey	9	11		22	
Submarginal Mill Race Covey *	9	13		44	
Miller Covey *	9		26		37
Sanctuary Covey	12	22		83	

* Ten game farm quail also released

Influx from adjacent coverts

Table 16.

SUMMARY OF OVER-WINTER HISTORY OF WILD TRAPPED QUAIL

Classes of Covey Ranges	Fall population 1941		Spring population 1942		Percent decrease	
	No. of birds trapped	Wild Origin unknown	No. of birds trapped	Wild Origin unknown	Wild trapped	Origin unknown
Good to Excellent Cook's Covey	30		29		3	
Sime Covey **	17		14		18	
Marginal to Good Foreman Covey ***		39		21 ##		46
Mahon Covey ***	23		13		43	
Cowan's Gap Covey	11		11		0	
Submarginal Mill Race Covey *	13		9		30	
Miller Covey		26		8 #		69
Sanctuary Covey **	22		12		45	

* One bird known shot

** Two birds known shot

*** Three birds known shot

*** Two to five birds known shot

Seven birds moved
from covey range## Twelve birds moved
from covey range

Table 17.
AVERAGE INCREASE AND DECREASE IN POPULATION OF GAME FARM AND WILD TRAPPED COVEYS
ON THE THREE CLASSES OF QUAIL RANGE--1941-42

Classification of Ranges	GAME FARM QUAIL		WILD TRAPPED QUAIL	
	Average percent increase over breeding season	Average percent decrease over winter	Average percent increase over breeding season	Average percent decrease over winter
Good to Excellent	115	14	89	10
Marginal to Good	30*	38	87**	30
Submarginal	35*	49	22**	48

* Wild trapped quail also present.

** Game farm quail also present.

Summary of Over-winter Histories of Wild and Game Farm Coveys

Throughout the fall, winter, and early spring of 1940-41, 29 coveys were studied and periodically checked. The following year 35 coveys were studied. Some of the coveys studied during 1941-42 were found on old covey ranges. Table 18 shows a summary of the average over-winter histories of coveys of quail on the three classes of quail range.

In order to determine the early fall population, a census was conducted in September of both years while the early winter census was made in December. The spring census for 1941 was taken in April, however, in 1942 the final count was made in March.

During the winter of 1940-41, 88 quail were live-trapped from ranges included in the study. However, during the following winter only 23 birds were captured on ranges that were under close observation. The trapped birds were not considered as losses.

It may be seen from Table 18 that with the exception of the coveys on good to marginal ranges, the losses from each covey were much lower during the second winter than during the first. Mortality due to hunting, however, was greater on all but the best ranges during the second year. The highest number of birds taken by hunters was on ranges of medium quality. The explanation of this probably lies in the fact that hunting was restricted on the best ranges while on the submarginal ranges the lower quail population was not inclusive to heavy hunting.

Climatic conditions during the winter of 1940-41 were moderate and resulted in a large breeding population the following spring. Coveys on the best ranges averaged 7 more birds when the second early

Table 18.

SUMMARY OF AVERAGE OVER-WINTER HISTORIES OF QUAIL ON THE THREE CLASSES OF QUAIL RANGE

Classification of Ranges	AVERAGE NO. BIRDS PER COVEY			Average No. of birds lost	Percent of original covey	Average * No. of birds shot	Number of birds trapped
	Early fall	Early winter	Spring				
Good to excellent 1940-41	11.7	15.2	12.8	2.5	21	2.0	25
1941-42	16.7	17.1	16.9	1.7	9	1.0	17
Avg. for 2 yrs.	15.2	16.1	14.9	2.1	14	1.5	21
Marginal to Good 1940-41	10.6	9.6	7.1	2.8	26	2.5	16
1940-42	17.0	14.3	12.6	4.2	25	4.0	6
Avg. for 2 yrs.	13.8	11.9	9.9	3.5	25	3.2	11
Submarginal 1940-41	11.7	8.9	5.3	5.7	48	1.8	47
1941-42	14.8	9.6	8.1	4.3	29	2.6	15
Avg. for 2 yrs.	13.2	9.3	6.4	5.0	38	2.2	31

* Average number of birds shot is included in the number lost.

fall count was made than during the first fall. Coveys on good to marginal and submarginal ranges averaged 6.4 and 3.1 more birds respectively during the second fall.

COVER UTILIZED BY BOB-WHITES IN SPRING AND SUMMER

One of the most important periods in the life history of the bob-white in the northern part of its range is the interim from mid-April to late September. The beginning of this period is indicated by whistling males and may be considered closed when the birds have banded together into coveys in the fall for the duration of severe weather.

In the spring of 1941 the severe winter weather had moderated by March 20 and nearly all the coveys had broken up by April 15.

From April 15 to September 15 special emphasis was placed on determining the cover requirements of quail during the period of nesting and rearing of young. Most of the nests and broods that were kept under observation were found on areas on which the investigators had previously worked; however, some were found on new areas. By confining the operations to the better known areas, it was possible to keep a more accurate record on the activity of the broods and of the use made by them of the various cover types.

Methods Used in Locating Nests and Broods

The first nest was found on May 17 and the last on September 3. Only one nest was found by use of a trained bird dog probably because the use of dogs was not permitted prior to August 20. The other nests were reported by farmers or found by systematic searching by the investigators of areas that were known to have been frequented by quail.

During the dog training season, the best use of bird dogs was obtained between 6 A.M. and 9 A.M. on clear days. However, on cloudy or damp mornings the dogs often worked until 10:30 A.M. without be-

coming fatigued. Ragweed pollen proved to be a discomforting factor to the dogs on dry mornings.

During a dry period from July 8 to July 28, it was possible to check the movements of broods surprisingly well. During this time numerous tracks were often seen along road shoulders and other places where the mineral soil was exposed.

The presence of dust baths was often used to determine whether a brood or covey had recently visited an area. Fecal droppings, while they are good indicators of the presence of quail during the fall and winter months, proved unsatisfactory during the summer and late spring. Young birds often roosted in scattered positions in dense cover and hence did not leave any large piles of droppings.

Cover Used by Whistling Bob-whites

Stoddard (1936) has shown that almost all of the familiar "bob-white" calls that are heard throughout the late spring and summer emanate from unmated or unsatisfactorily mated males. This condition may be due to a lack of physical prowess on the part of the male or an insufficient number of females to go around.

In the spring of 1941 the first whistling male was heard during the fourth week of April and the last "bobwhite" call that was recorded by the investigators was on August 28.

Whistling was heard throughout the summer but the greatest amount of calling was done from May 15 to July 1. Numerous single males were noted after July 1 but the whistling was restricted to scattered individuals. On one area, however, five males were heard whistling within

a radius of 200 yards in early July.

As a rule, on clear days, whistling did not begin until shortly after sunrise. With few exceptions, the beginning of whistling seemed to be directly correlated with light intensity and usually occurred as soon as it became light enough to discern houses and other large objects one mile distant. On cloudy mornings whistling began appreciably later than during clear weather. The birds whistled steadily until early afternoon and then gradually subsided. Between 3 and 4 P.M. whistling was resumed for a period of 1 to 2 hours.

During the course of the investigation it was never possible to approach a whistling male closer than 20 yards. The birds ceased whistling as soon as the observer approached. Although it was not possible to observe them closely while they were whistling, it was very easy to locate their position after listening to several calls. During this period of whistling, the birds were exceptionally difficult to flush and in most cases they chose to leave the vicinity by running or walking instead of on the wing.

Throughout the late spring and summer 332 separate observations were made on whistling male quail. Table 19 shows the use of different cover types for whistling.

Table 19.

COVER TYPES USED BY WHISTLING MALE QUAIL

Cover Type	No. of whistling male quail	Percent of total
Fence rows (with vegetation)	63	19.0
Standing corn	31	9.3
Orchards	30	9.0
Gardens (vegetable and flower)	27	8.1
Fence rows (with no vegetation)	25	7.5
Clover fields	22	6.6
Bean fields	17	5.1
Woodland edges	17	5.1
Pea fields	14	4.2
Tomato patches	13	4.0
Alfalfa	12	3.7
Grassland	12	3.7
Timothy	8	2.4
Wheat stubble	7	2.1
Marshland	6	1.8
Lespedeza	6	1.8
Wasteland	6	1.8
Brushland	5	1.5
Potato fields	4	1.2
Pine plantation	4	1.2
Sweet clover	3	.9
TOTAL	332	100.0

Because of the fact that the types listed in Table 19 did not cover equal areas in the county it cannot be said that a type in which 30 whistling males were heard attracted more birds than one in which 22 were heard. However, it seems reasonable to assume that the cover types at the top of the list attracted more whistling males than those at the bottom of the list. Certainly fence rows were the favorite whistling areas of male quail. Although fence rows occupy a small percent of the total area of each covey range, more than twice as many males were heard in this type of cover than in any other. Fences that were surrounded with vegetation were considered separately from those without surrounding vegetation. In vegetated fence rows the birds either whistled while on the ground or perched in trees and shrubs; however, when whistling from fences with little or no surrounding vegetation, they were usually perched atop a rail or post.

It was interesting to note that no whistling was heard from the interior of woodlots, although 17 different birds were heard whistling from the edge of wooded areas.

The birds seemed to prefer somewhat sheltered or shaded places and although a large number was heard calling from cultivated areas, they were never more than 15 or 20 yards from possible cover.

Unfortunately it could not be determined whether the same bird used the same spot for whistling day after day. It was often possible to hear birds calling from the same spot on different days but no evidence can be presented to establish the fact that they were identical birds.

From May 15 to July 1, when most of the whistling occurred, temperature did not seem to be a factor in determining the amount of whistling that could be heard. As many calls were heard on cool mornings as were heard on warm mornings. On May 25 a light frost occurred in the lowlands yet the birds whistled enthusiastically.

During a prolonged rain, whistling either ceased entirely or was restricted to a very few scattered individuals, however, whistling usually continued during several late afternoon showers. Stoddard (1936) states that quail often whistled spiritedly both before and after sultry afternoon showers. However, during the course of this study, no increase was noted either before or after the frequent light showers.

Cover Utilized by Mated Bob-whites

Seventy-six observations were made on 40 pairs of quail. On numerous occasions male and female birds were seen in the same vicinity, but unless their behavior was such that it could be safely assumed that they were mated, they were not considered in this part of the study.

It was often possible to observe the birds on the ground, because the vegetation was not dense during the beginning of the mating period. They seemed reluctant to fly when approached and usually ran ahead of the observer and attempted to conceal themselves in the nearest cover. After June 1, however, the increased vegetative growth made such observations extremely difficult and rare.

Sixty-three, or 83 percent, of the total number of observations were made prior to June 1, while only 13 or 17 percent were made after this date. It is believed that the decline in the number of the

observations at that time was due to the screening effect of the vegetation and not to any significant decline in the number of mated birds that were present. Because of this fact, it was not possible to ascertain the length of the mating season by observation of mated pairs.

The first pair was seen on May 3, or one week after the first "bobwhite" call was reported. Stoddard (1936) states that the beginning of pairing coincides with the first bobwhite call, however, the investigators received reports from several sources in Franklin County that a few pairs of quail had been seen as early as April 10.

Fence rows of medium density and areas of brushland were heavily used by mated bob-whites at all times. Fence rows that were adjacent to relatively open fields such as young corn, peas, beans, tomatoes, and potatoes were frequently used as feeding grounds. Close scrutiny revealed that the birds fed heavily on small insects that were abundant during May. One pair was seen feeding along the edge of a young corn field. Both male and female would dart into the corn for a distance of from four to six feet, seize an insect, and return quickly to the fence row. As the pair fed, they moved steadily along the fence row away from the observer until they were lost from view.

Open brush areas carpeted with a light growth of blue grass, crab grass (*Digitaria* sp.), and wild rose with an upper story of black locust and hazel alder seedlings attracted numerous pairs.

Abandoned fields in which the largest percent of the vegetation was blue grass, poverty grass, asters, goldenrod, wild carrot, dewberry, rose and milkweed, were also used by the birds. In such areas,

observations were often made in clumps of raspberry, blackberry, or smooth sumac. It was noted that during this early part of the breeding season, the bob-whites preferred to range over areas that were not exceptionally dense. Insects were more abundant in the more open places and probably provided the attraction for the quail. At no time was a pair observed in the interior of a woodlot, although 7.5 percent of the observations were made near woodland edges.

The remaining 20 observations were made from roadsides (from an automobile), in truck and flower gardens, and in orchards, sweet clover patches and alfalfa fields. As in the case of the whistling birds, these figures do not represent an exact preference by the birds for the stated cover types, but merely indicate the relative use made of them. Table 20 shows a summary of the cover types used by mated quail.

Table 20.

COVER TYPES USED BY MATED QUAIL

Cover Type	Number of observations	Percent of total
Fence rows	20	27.5
Brushland	19	25.0
Wasteland	11	15.0
Woodland edges	8	7.5
Roadsides	6	7.5
Gardens	4	5.0
Young corn fields	4	5.0
Orchards	2	2.5
Sweet clover	2	2.5
Alfalfa	2	2.5
TOTAL	76	100.0

It was impossible to determine the daily or absolute range of a mated pair of bob-whites, however it was often possible to return to a locality several days after locating a pair and find them within 150 to 300 feet of the spot where they were first seen. On the Reilly property, west of Quincy, one pair was observed seven times in six days in a shallow drainage ditch that extends approximately 300 feet up a small depression in the side of a hill.

The vegetation here consisted of approximately 80 percent blackberry, green briar (Smilax rotundifolia), hazel alder, black locust and raspberry. Other species present were wild grape, giant ragweed, asters, milkweed, toad flax (Linaria sp.), and touch-me-not (Impatiens biflora). All evidence seemed to indicate that a mated pair occupied a much smaller range than a fall or winter covey.

Nests and Nesting Cover

It has been shown by many authorities that the nesting season and the period of incubation that follows may well be an important if not the most important period in the life history of the bob-white. The number of adult birds that will be present when the coveys begin to form in the fall depends first; on the success of the females in bringing off the broods successfully and secondly on the ability of the young to survive the juvenile period of growth.

Fifteen nests were found and studied during the spring and summer of 1941. In addition to the 1941 nests 6 additional ones that were found in 1940 are included in this data.

Because of the relatively low quail population, the location of

nests was extremely difficult and rare. Use of a trained bird dog was not possible during this season. All the nests that were located were either found by means of direct search in an area where quail were known to be present or were reported by farmers, sportsmen, or highway mowing crews. Once a nest was located, all possible care was exercised to prevent the formation of a definite path or trail to the nest.

No instances of nest crowding were encountered in Franklin County during the course of the study. Stoddard (1936) found that during years when nesting cover was at a minimum, bob-whites frequently nested within a few feet of each other and in one case reported that three females deposited their eggs in one nest. Numerous residents of Franklin County reported that prior to the winter of 1935-36, as high as eight to ten nests could be found in a 15 to 20-acre timothy or alfalfa field. Two nests were known to have been constructed 135 feet apart by the same bird. However, both were unsuccessful nesting attempts.

Eleven nests (52 percent of the total number) were found near places where mated pairs were frequently observed, however, careful search in areas that were used by 30 pairs failed to reveal any nests. This does not mean that none of the 30 pairs was successful in their nesting attempt. The difficulty in locating nests probably offers a satisfactory explanation for this fact. Twenty four broods (71 percent of the total number) were observed on areas where no nests were found.

Fence rows of medium density and areas close to fence rows were preferred by mated bob-whites for nesting purposes. This fact was substantiated by the findings of the investigators and from many reports of farmers and sportsmen.

The distribution of the 21 nests in the various cover types is summarized in Table 21.

Table 21.

DISTRIBUTION OF NESTS IN THE VARIOUS COVER TYPES

Cover Type	Number of nests	Percent of total
Fence rows	5	23.7
Roadsides	3	14.3
Wasteland	2	9.5
Woodland edge	2	9.5
Alfalfa	2	9.5
Lespedeza	1	4.8
Sweet clover	1	4.8
Red clover	1	4.8
Orchard	1	4.8
Timothy	1	4.8
Timothy stubble	1	4.8
Grassland	1	4.8
TOTAL	21	100.0

Nest Construction: Grass was unquestionably the most important material used in the construction of the 21 nests that were studied. Thirteen of the 21 nests were built entirely of grass (fig. 18), while five were constructed of grass and other materials. Only three nests contained no grass. The material used in nest construction, with the exception of grass, was probably an expression of the most easily obtained vegetation.



Fig. 18. A roadside nest constructed entirely of grass.

This nest was later destroyed by a dog.



Fig. 18. A roadside nest constructed entirely of grass.

This nest was later destroyed by a dog.

Table 22, shows the use of different materials for nest construction.

Table 22.

MATERIALS USED FOR NEST CONSTRUCTION

<u>Materials used</u>	<u>No. of nests</u>	<u>Percent of total</u>
Grass	13	62
Grass and timothy	2	9
Footail and red clover	2	9
Grass and millfoil (<u>Achillea millifolium</u>)	1	5
Grass and violet stems (<u>Viola</u> spp.)	1	5
Grass and sweet clover	1	5
TOTAL	21	100

The time of nest construction did not affect the type of materials used except in that it more or less governed the availability of the different materials. Grass, however, was found in the first nest to be located (May 20) as well in the last (September 3).

Concealment of Nests: Ten, 48 percent, of the 21 nests were covered with a dense lattice or grass or other vegetation. Five nests, 23 percent of the total number, were only partially covered, while six, or 29 percent, were uncovered except for what cover the adjacent vegetation provided. Where the incubating bird had made no visible effort to construct a lattice or roof, the nest was usually built in an inconspicuous or sheltered place.

Eight nests, 38 percent of the total, were invisible regardless of whether or not the incubating bird was on the eggs. In nine nests, 43 percent, the eggs were visible only when the incubating bird had left the nest (fig. 19) and in four nests, 19 percent, the incubating bird was readily visible when the nest location was known.

Nests that were built in fence rows and woodland edges were nearly all invisible at all times while those built in grassland (fig. 20), lespedesa and timothy stubble were easy to observe even when the incubating bird was present.

Drainage of Nest Sites: None of the nests under observation were built in swampland or very poorly drained areas. Five nests, 23 percent, were constructed in places that were poorly drained and subject to repeated splashings from traffic on the roads (fig. 21). The remaining 16 nests were built on well drained sites.

Nests of Game Farm Quail: Four nests of game farm quail were located and studied. Three were built by Type B quail and the other by a Type A pair. No significant differences in the nesting habits of the game farm or wild quail were noted. Two of these nests were successful and two were destroyed by dogs.

Rearing of Broods

From June 1, to September 15, 162 observations were made on 34 different broods of young quail. During June, July and early August either the adult male or female, or both; were found with the brood. However, after mid-August, groups of young birds were often flushed

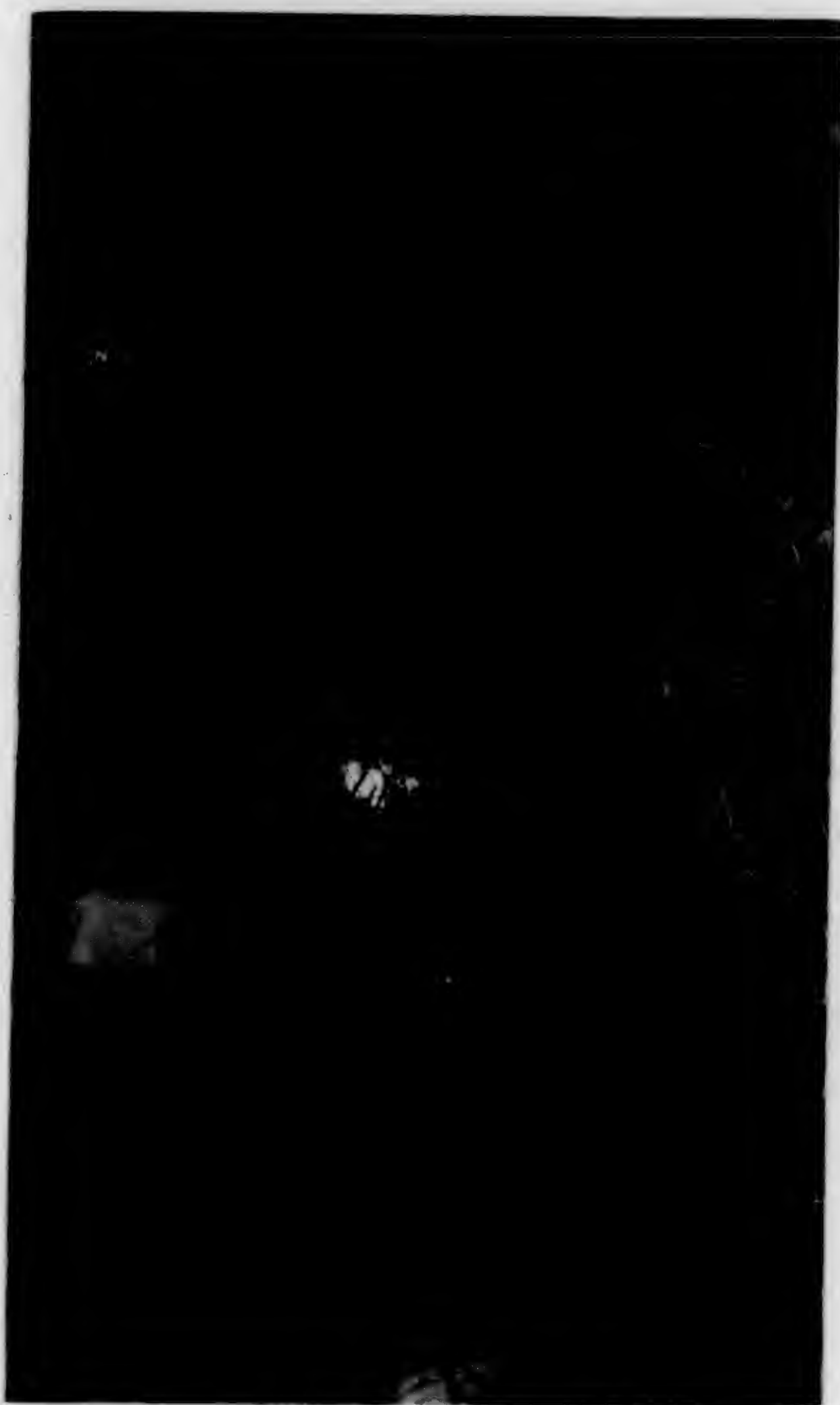


Fig. 19. A partially covered
nest in a timothy
stubble field.



**Fig. 19. A partially covered
nest in a timothy
stubble field.**



Fig. 20. The site of the nest shown in Fig. 19 --
showing its relation to the surrounding cover.



Fig. 20. The site of the nest shown in Fig. 19 --
showing its relation to the surrounding cover.



Fig. 21. The location of a typical roadside nest.



Fig. 21. The location of a typical roadside nest.

unaccompanied by either parent. By September, the adult-like appearance of the young birds often made them difficult to identify from the older birds.

The largest number of observations on broods was made in August. By that time most of the young birds were able to fly, and when approached, the entire group would spring into the air and fly as far as possible. This distance varied from 10 to 150 yards depending upon the strength of the birds. Before the members of a brood were able to fly, the only indication of their presence was the behavior of the adult bird. The "broken wing" ruse was often employed to decoy the observer away from the young birds.

Movement of Broods: After hatching, the young birds usually could be found in the vicinity of the nest for three or four days, provided a sufficient source of food and cover was available. The greatest distance that a brood of less than one week of age moved (in one day) was 200 yards. This group was hatched at 3 P.M. and had moved 200 yards by noon of the following day. At that time the observer discovered them in a dense growth of blue grass along a stream bank. Three of the young birds scrambled out on some floating vegetation and easily swam across the stream. The stream was six feet wide at this point and the current was appreciable but none of the three birds showed any harmful effects.

Use of Stubble Fields: Previous to the cutting of small grains and timothy, the use of these types by young quail was negligible if they were used at all. No observation of any brood was made in these fields

previous to cutting and mowing. This might have been due to the fact that most of the grain fields were cut before the majority of the broods made their appearance. Wheat and rye stubble was used heavily as feeding grounds by the older birds in late summer or early fall. Most of the observations in wheat or rye stubble fields were made in early morning, however, a few birds were found in this type during late afternoon.

Broods of less than four to five weeks of age preferred timothy stubble in which to feed. The supply of small insects was noticeable higher in the timothy stubble than in either wheat or rye stubble. Timothy stubble was also used by older birds in late summer.

During mid-day, in early September, it was not uncommon to find a covey feeding around straw piles in stubble fields. The birds apparently did not mind the noticeable lack of cover surrounding these piles.

No observations of broods were made in barley stubble fields.

Use of Alfalfa and Clover Fields: Alfalfa fields, while they were used heavily as roosting sites in early fall, did not attract broods during the summer. Only four observations were made on birds in this cover type. Two observations were made in sweet clover but red and alsike clover were used heavily in the mornings after the sun had dried the vegetation.

Use of Potato, Tomato, Buckwheat, Pea and Bean Fields: These cover types were considered as one type in this discussion because of the equal amount of utilization by young quail. Apparently the bare ground and large insect supply in these types attracted the birds. A certain amount of shade from the direct rays of the sun was provided by these plants and

as a result, the use of these types throughout the day was heavy and second only to corn fields.

Use of Corn Fields: The largest number of observations in any single cover type was made in the edges of standing corn fields adjacent to fence rows of medium density. The excellent shade, lower temperatures, and large insect supply in this type probably attracted the birds. Some use of corn fields was made during light rain storms. During rainy periods the birds often sought cover in fence rows without a dense carpet of grass. While grassland provided good cover for birds of less than two weeks of age during dry weather, they seemed to avoid this type during periods of rainy weather and heavy dews. Most corn fields were carpeted with a heavy growth of foxtail (fig. 22) which provided an excellent source of food during late summer and early fall.

Use of Wasteland: Until the young birds attained the age of from four to six weeks, waste fields and brushy areas were not used to any appreciable degree. As was stated above, dense fence rows were not used until September. However, fence rows of light and medium density as well as waste areas with a light or medium cover were frequently used in mid-morning.

Use of Orchards: When orchards were present on areas frequented by young birds, they were heavily used particularly during the early morning. Foxtail and lesser ragweed were especially abundant in late August and early September in orchards. Grasshoppers were also abundant in this type and formed an important source of food throughout the early fall.



Fig. 22. Cornfields with a heavy growth of foxtail provided an excellent source of food during late summer and early fall.



Fig. 22. Cornfields with a heavy growth of foxtail provided an excellent source of food during late summer and early fall.

Some apple (Pyrus malus) and peach (Prunus persica) orchards in the western part of the Cumberland Valley were planted in buckwheat.

Use of Woodland: The lack of the use of woodlands by young quail was very apparent. No observations were made on them in this type throughout the summer. However, in early fall an increasingly larger number of birds was observed along woodland edges particularly if they were adjacent to wheat stubble fields. In one case, however, a dry stream bed and adjacent brushy cover that passed through an open park-like grove of trees was used by a brood of quail. Dust baths were common in this creek bed. No indication of a need for water by quail from streams or ponds was found. Birds were found close to streams and ponds only when food and cover were present and were required by the birds.

Cover Types Used for Dusting

During the period from April 15 to September 15, 75 separate observations were made on dusting areas used by bob-whites. The largest number (36) of dust baths was found from August 1 to September 15. Twenty one were located during the period from June 1 to August 1. Nineteen of this number were found during a dry period from July 8 to July 28, and 18 were located prior to June 1. Most of the dust baths that were found prior to July 15, were used by single birds, however, after that date it soon became evident that entire broods were dusting together.

The presence of feathers in or near a bath was often valuable in establishing the identity of the bird, or birds, that dusted there. Table 23 shows the distribution of dusting areas in the various cover types.

Table 23.

DISTRIBUTION OF DUSTING AREAS IN THE VARIOUS COVER TYPES

Cover Type	No. of dusting areas	Percent of total
Bare areas next to fence rows	18	24.0
Truck patches	17	22.7
Excavations of burrowing mammals	12	16.0
Edges of pastures	12	16.0
Corn fields	6	8.0
Roadsides	4	5.3
Orchards	3	4.0
Woodland edges	2	2.7
Barnyards	1	1.3
TOTAL	75	100.0

The large number of dust baths in the first four types in Table 23 namely: Bare areas next to fence rows, truck patches, woodchuck holes, and bare areas in pastures and grassland indicated a decided preference for these cover types as dusting areas.

Roosting Cover

From late June to the end of August, the broods of quail roosted in fence rows and thickets of Japanese honeysuckle, blackberry and raspberry. The younger broods seem to prefer the more dense roosting cover. Throughout these months no evidence of a characteristic roosting circle was found. That young broods frequently roosted in dense thickets of Japanese honeysuckle, was shown by frequent observations of scattered piles of droppings in this type of cover. Neither evidence of tree

roosting nor of broods using the same roost for more than one night was found during the course of the investigation.

On September 4, the first evidence of a roosting circle was discovered. During the first two weeks of September, thirty six of these roosts were found. Alfalfa fields and timothy stubble were the favorite roosting places during early September. The birds seemed willing to roost in the center of large fields and many roosts were found 125 yards from the nearest woody cover. Table 24 shows the cover types used for roosting.

Table 24.

COVER TYPES USED FOR ROOSTING

Cover Type	Number of roosts	Percent of total
<u>JUNE, JULY, AUGUST</u>		
Fence rows	21	40.5
Brushland	19	36.5
Alfalfa	8	15.4
Orchard	2	3.8
Grassland	2	3.8
<u>TOTAL</u>	<u>52</u>	<u>100.0</u>
<u>SEPTEMBER 1 to 15</u>		
Alfalfa	16	44.4
Timothy stubble	6	16.7
Fence rows and brush	5	13.9
Red clover	5	13.9
Lespedeza	2	5.5
Wheat stubble	1	2.8
Woodland edge	1	2.8
<u>TOTAL</u>	<u>36</u>	<u>100.0</u>

PREDATION IN RELATION TO COVER

A total of approximately 884 quail were studied throughout the 21 months that this investigation was conducted. Thirty eight or 4.3 percent were known to have been lost by predation of all kinds. Unless definite proof of a predatory act was found it was not recorded as a loss from predation. Proof that a kill had been made was usually established by finding some form of quail remains, by seeing the predator with its prey, or from reliable reports.

A list of the predators, together with the number of kills made on each class of range is shown in Table 25. Destruction of a nest was considered as one act of predation.

House cats (Felis domestica) were by far the most notable predators and accounted for 42 percent of all kills made. Predation by both dogs (Canis familiaris) and cats was most noticeable when the covey ranges on which it occurred was close to a town or group of dwellings. Hawks were classed as "unknown" whenever there was any doubt as to their identity. Gray fox (Urocyon cinereoargenteus) populations were higher on ranges close to mountain timber than in other parts of the valley, however, the one bird known killed by a fox was taken two miles from the base of the mountains. Crows (Corvus brachyrhynchos brachyrhynchos) accounted for the destruction of one nest.

The differences in the protective quality of the cover on the different classes of ranges is not strikingly shown by Table 25. The relatively good physical condition of the birds and the relative abundance of food and cover due to the mildness of the winter probably explains this fact.

Table 25.

SUMMARY OF ALL ACTS OF PRELATION AND THE CLASSES OF QUAIL RANGE ON WHICH EACH OCCURRED

Predator	Classification of Ranges						TOTAL
	Good to Excellent		Marginal to Good		Submarginal		
	No. of kills	Percent of total	No. of kills	Percent of total	No. of kills	Percent of total	
House cats	3	27	7	58	6	40	16 42
Unknown hawks	3	27	2	17	3	20	8 21
Dogs	3	27	1	8	2	13	6 15
Cooper's Hawks	1	9	1	8			2 5
Osprey					1	7	1 3
Crows					1	7	1 3
Gray fox					1	7	1 3
Unknown	1	9	1	8	1	7	3 8
TOTAL	11	99	12	99	15	101	38 100

An analysis of the cover in which acts of predation occurred on the three classes of quail range is shown in Table 26.

Thirty nine percent of all kills were made on areas adjacent to fence rows. Twenty six percent were near fence rows of light density. It probably is reasonable to assume that the birds were attacked while seeking cover in the nearby fence rows vegetation.

One bird was killed in a quail trap by a cat. Four other birds were in the trap at the time but the cat had succeeded in killing and partially consuming but one quail.

Table 26.

ANALYSIS OF COVER IN WHICH PREDATION OCCURRED ON THE THREE CLASSES OF QUAIL RANGE

Cover types in which predation occurred	Classification of Ranges						TOTAL	
	Good to Excellent		Marginal to Good		Submarginal			
	No. of kills	Percent of total	No. of kills	Percent of total	No. of kills	Percent of total		
Areas adjacent to fence rows I	1	9	2	17	7	47	10	26
II	2	18			1	7	3	8
III	1	9	1	8			2	5
Wasteland	1	9	2	17	2	13	5	13
Interior or edge of woodlots	4	36	1	8			5	13
Roadsides	2	18	1	8			3	8
Slashing			1	8			1	3
Grassland							2	5
Pastured brush					2	13	2	5
Timothy stubble					2	13	2	5
Orchard					1	7	1	3
Standing corn			1	8			1	3
Barnyard			1	8			1	3
In quail trap			1	8			1	3
TOTAL	11	99	12	98	15	100	38	101

Table 27 shows the time of year and the condition of the ground when each kill was made. The large number of kills made during the period of the year when cover was at its best was probably due to the fact that a large number of them were recently released game farm quail and juvenile birds who had not as yet developed good powers of flight. The relatively large number of kills made on poor ranges when the ground was bare of snow as compared to kills made in the snow was probably due to the relatively short time that the snow cover remained during both years.

Table 27.

CONDITION OF GROUND AND VEGETATION WHEN EACH ACT OF PREDATION OCCURRED

Condition of Ground	Classification of Ranges						TOTAL
	Good to Excellent		Marginal to Good		Submarginal		
	No. of kills	Percent of total	No. of kills	Percent of total	No. of kills	Percent of total	
Snow cover under 2 inches	1	9	2	16	3	8	
Snow cover over 2 inches	1	9	4	34	4	27	24
Ground bare-- Late fall, winter and early spring	1	9	2	16	6	40	24
Leafy vegetation present-- Late spring, summer and early fall	8	73	4	34	5	33	44
TOTAL	11	100	12	100	15	100	100

Table 28 shows the distribution of the total number of kills among the game farm, wild trapped, and wild quail.

Game farm quail showed a higher mortality due to predation on sub-marginal ranges not only because of the lack of cover but because of the fact that 60 percent of all the game farm quail were released on this class of range. Wild trapped birds were much less susceptible to predation than the game farm quail. The large number of wild quail under observation probably explains the large amount of predation on birds in this category.

Handley (1938) reports that in Virginia, Sharp-Shinned Hawks, Cooper's Hawks (Accipiter cooperi), crows, housecats, skunks (Mephitis nigra), weasels (Mustela spp.), rats (Rattus sp.) and black snakes (Coluber constrictor) were the greatest enemies to quail. Although skunks, weasels, opossums (Didelphis virginiana), black snakes, puff adders (Heterodon contortrix), Sparrow Hawks (Falco sparverius sparverius), Eastern Red-tailed Hawks (Buteo borealis borealis), Northern Red-shouldered Hawks (Buteo lineatus lineatus), Barred Owls (Strix varia varia), and Great Horned Owls (Bubo virginianus virginianus) were found on many ranges, evidence of predation by these animals was not encountered.

Table 28

DISTRIBUTION OF KILLS AMONG GAME FARM, WILD TRAPPED AND WILD QUAIL

Prey-- Type of Quail	Good to Excellent		Marginal to Good		Submarginal		TOTAL	
	No. of kills	Percent of total	No. of kills	Percent of total	No. of kills	Percent of total	No. of kills	Percent of total
Game Farm Quail								
Type A	1	9			2	13	3	8
Type B	5	45			2	13	7	19
Wild Trapped Quail			1	8	1	7	2	5
Wild Quail	5	45	11	92	10	67	26	68
TOTAL	11	99	12	100	15	100	38	100

EFFECTS OF AGRICULTURAL PRACTICES ON BOB-WHITE ENVIRONMENT

Agricultural practices, in the northern part of the bob-white's range, have a direct bearing on the suitability of the food and cover conditions. The abundance of quail can be easily correlated with the agricultural development of an area.

Leopold (1931) has pointed out that increases and decreases of the quail population in the north-central states can be explained by a review of the four stages in the agricultural development of that portion of the country. The same four stages can be found in the history of agriculture in south-central Pennsylvania.

The virgin, or presettlement, stage was characterized by almost virgin forest conditions. Quail were found in relatively small numbers around natural openings in the forest. A period of crude agriculture followed and the grain fields, numerous brush patches, and other man-made clearings provided a large amount of food and cover. This resulted in a relatively large quail population. With the coming of highly efficient farm machinery, the farming became more intense and an increasingly smaller amount of suitable cover was allowed to remain on each farm. Hunting pressure increased and the quail population on most areas dipped to a dangerously low point. During the agricultural depression that followed some lands reverted naturally to weed fields and brush areas became more numerous on each farm. At the present time large areas of marginal or submarginal land provide some of the best territories for quail. These areas, however, are not sufficient enough to enable the quail to build up and maintain a high population. It is generally accepted that in order to maintain a high population, there

must be a modification of the present condition of the land to raise its carrying capacity.

The eastern and western borders of the county are devoted more exclusively to the growing of small grain and truck crops and to orcharding. Dairy farms are more common in the central portion of the county. Large fields, surrounded by fence rows with little or no vegetation, large heavily grazed pastures, and bare corn fields are characteristic of this latter area (fig. 23). Corn is removed in the fall to be cut up for ensilage on most of these farms. This practice removes a large supply of winter food and cover for quail. The practice of cutting and shocking corn in the fall and planting winter wheat in the available rows is common over most of the county. This is almost as detrimental to quail as the complete removal of the corn. Except for a very few ears that remain on the stalks in the shocks, no food is left that is available for quail during periods of deep snow. All corn is husked in the field. This practice greatly increases the volume of food available throughout the fall in the form of waste grains that fall from the ears. Standing corn with imperfect ears remaining on the stalks adjacent to dense brushy cover is the best winter cover for quail.

No stubble is plowed under until early spring. This practice prevents the loss of great quantities of weed seeds and waste grain that occurs when stubble fields are plowed in the fall. The increasing use of movable electric fences allows the pasturing of stubble fields. This practice greatly reduces the height and abundance of such important sources of quail winter food as ragweed and foxtail. Alfalfa fields



Fig. 23. Large fields and an almost total lack of cover characterized the central part of the county. Dairy farms were common in this section.



Fig. 23. Large fields and an almost total lack of cover characterized the central part of the county. Dairy farms were common in this section.

provided roosting cover during the fall, winter, and spring. The removal of three crops of alfalfa annually prevents the vegetation from attaining sufficient height for ideal roosting cover. When only two crops are removed, one in June and the second in July, the vegetation often reaches a height of 8 to 12 inches by early fall.

Korean lespedeza is becoming increasingly popular as a pasture and soiling crop in the extreme southern part of the county. If not over grazed, this crop provides excellent fall and winter food for quail. One large covey fed almost entirely on a 10 acre lespedeza field throughout both winters.

The acreage in tomatoes, peas, and other truck crops is increasing. The tomato plants remain above ground over winter. Very little winter cover is provided but the use of these fields in summer by quail is notable. The large insect supply and growth of herbaceous plants probably attracts the birds.

Large orchards are usually well cultivated and ground cover is at a minimum. Some large orchards are planted in buckwheat. This source of food attracts quail in early fall when the waste grains are left after harvesting.

Livestock raising is becoming increasingly popular. This has resulted in the retiring of large areas to permanent pasture. This has greatly reduced the suitability of the land for quail. Where the acreage in grassland is small, woodlots are usually heavily pastured (figs. 24 and 25). This practice removes the low shrubby growth that provides cover for quail during the winter. One hundred percent of all woodlots on submarginal ranges were pastured; 33 percent were



Fig. 24. A typical pastured woodlot in winter. The lack of low cover is apparent.



Fig. 25. Reproduction and brush patches were commonly found in unpastured woodlots.



Fig. 24. A typical pastured woodlot in winter. The lack of low cover is apparent.



Fig. 25. Reproduction and brush patches were commonly found in unpastured woodlots.

pastured on good to marginal ranges, while only 4.8 percent was grazed on the best ranges.

The burning and brushing out of fence rows and brush patches in the early spring and fall is a common practice. This results in a serious depletion of both winter and nesting cover. Grassland is often burned in early spring to increase the summer forage for cattle. Light burning in the early spring apparently does not injure the cover (fig. 26) provided it is done early enough so as not to interfere with nesting quail.



Fig. 26. This brush patch was frequented by eight quail and six Ring-Necked Pheasants (Phasianus colchicus torquatus) during the winter of 1941-42. Light burning during the early spring of 1941 did not impair the value of this cover.



Fig. 26. This brush patch was frequented by eight quail and six Ring-Necked Pheasants (Phasianus colchicus torquatus) during the winter of 1941-42. Light burning during the early spring of 1941 did not impair the value of this cover.

EFFECTS OF FORESTRY PRACTICES ON BOB-WHITE ENVIRONMENT

Since the bob-white is primarily a bird of agricultural land, it is not greatly affected by forestry practices in Franklin County. Approximately 29 percent of the total land area was covered with large blocks of forest land and mountain timber. Several reports of quail migrating from the valley to areas of slashings on the mountain sides were received and investigated, however, no evidence of such a move could be found.

A few woodlots were used as a source of fuel wood and fence posts. Tops of fallen trees were usually cut for fuel and the remaining brush was scattered. Very few instances of brush being piled were found in the county. Quail usually visited areas where brush was found in piles during snowy periods. Roosts were often found in tops of fallen trees.

Plantations of coniferous trees were found to be beneficial to quail. Three pine and Norway spruce (Picea excelsa) plantations were found to be heavily utilized by quail during fall, winter, and early spring.

RECOMENDATIONS FOR IMPROVING BOB-WHITE COVER

Errington (1935) states that the management of the northern bob-white consists of three important practices namely: raising the carrying capacity of the land to a satisfactory level and maintaining it there, strengthening individual coverts against blizzards and sleet storms, and the wise regulation of hunting.

In Franklin County, Pennsylvania, quail hunters are not responsible for excessive mortality among quail. There were a few coveys reported to the investigators that were shot below the safe limit but these were exceptional. Gerstell (1939), has shown that, within limits, the size of a covey determines its ability to stand cold and therefore it should not be shot below a certain limit. Management, therefore, consists mainly of the modification of land use and treatment to suit the preferences and needs of quail. No shortage of cover was found in the summer and early fall and hence emphasis should be placed on the maintenance of proper cover during the critical winter period.

The proper distribution of food and cover is as important as the total amount that is found on each covey range. If food patches are to be planted the importance of locating them near dense cover cannot be over estimated. The value of food patches has been a controversy. Wilson (1938) found that in Virginia, food patches for quail were not entirely successful. Songbirds and mice (Muridae) usually consumed 80 to 90 percent of the food by early winter. Heavy snows usually weighted down and covered the food supply; natural reseeding was difficult to obtain and the cost was prohibitive. English and Bennett

(1940) found that corn ranked second among the foods found in 89 bob-white crops that were obtained from quail shot in Pennsylvania in 1938 and 1939. They recommended that several rows of partially picked corn adjacent to woody coverts be allowed to remain over winter. This practice has been proven to be as good, if not better than the planting of food patches. Planting field borders and odd corners with buckwheat, soybeans, and Korean lespedeza is an excellent method of providing food for bob-whites during fall and winter. Narrow strips of plowed land adjacent to brushy covers is beneficial in that weeds soon become established and provide an excellent source of weed seeds.

Pasturing of stubble fields is not recommended. Grazing greatly retards the growth of ragweed, and foxtail. These are two staple foods of quail during fall and winter. It is advisable to allow alfalfa stubble to recover after the second cutting in July and to attain sufficient height by fall to provide roosting cover for the winter.

Pasturing of both woodlots and brush areas is detrimental to bob-white environment. Along the edges of woodlots that had been heavily pastured it is advisable to create some form of temporary shelter by building brush piles 4 feet high and 10 to 12 feet in diameter. The value of feeding areas can often be improved by building brush shelters close by. Piling brush in orchards is recommended.

Unpastured woodlots can be improved by cutting out large "wolf" trees in order to create openings under which shrubs and herbaceous plants can grow.

Burning, grubbing out, and cutting fence rows is highly unfavorable. Dense fence rows adjacent to standing corn, stubble fields or

weed fields were found to be the most important combinations of cover types on the best covey ranges. Many fence rows can be improved by planting honeysuckle, wild grapes, black locust, blackberry, raspberry and other densely growing shrubs and vines.

SUMMARY

1. The purpose of this survey was to seek both quantitative and qualitative information on covey ranges of the Eastern Bob-white in Franklin County, Pennsylvania and to determine what constitutes "good", "fair", and "poor" quail range.
2. It is thought that the periodic severity of winters in south-central Pennsylvania is the greatest factor in preventing quail from reaching and maintaining a high population.
3. The present agricultural system of the county is built upon diversified farming, livestock production, dairying and fruit growing.
4. During the winters of 1940-41 and 1941-42, temperature, rainfall, and snowfall were about average. Franklin County snowfall averages 28.5 inches annually and the normal daily average temperature for the winter months is 31 degrees Fahrenheit. Precipitation during the breeding season of 1941 was nearly average.
5. Aerial photographs with a scale of 8 inches to the mile were used as base maps in mapping covey ranges.
6. Covey ranges were classified "good to excellent", "marginal to good", and "submarginal" depending on the suitability of cover for quail and the spring survival on each range.

7. Good to excellent covey ranges averaged 83 acres and were usually found on the poorer agricultural soil.

Unpastured brush, woodlots, and weed fields were usually found adjacent to feeding areas. Unpastured stubble fields were important sources of fall and winter food.

Fence rows of Nos. II and III density averaged 72 percent of the total length of fence rows on each range. Blackberry, raspberry, Japanese honeysuckle were important fence row species.

8. Marginal to good quail ranges averaged 72 acres and generally speaking, were found on better soil types than the best ranges. Farming is more intensive on this class of range.

Vegetation on marginal to good ranges differed from that of the best ranges qualitatively rather than quantitatively. Brushland was noticeably absent but weed fields occurred on 77 percent of these ranges. A large number of woodlots and stubble fields were pastured and hence were of less value to quail than those found on the best ranges.

Fence rows of Nos. II and III density averaged 52 percent of the total as compared to 72 percent on the best ranges. Blackberry, raspberry, Japanese honeysuckle, and wild grape were present but not abundant.

Standing corn occurred on 11 percent of these ranges as compared to 42 percent on the best ranges.

9. The average size of all submarginal ranges was 74 acres. Forty eight percent of these ranges occurred on soils of high productivity

and all were characterized by low quality and poorly distributed cover and feeding areas. No standing corn was present.

Large areas of grassland, pastured stubble and weed fields, woodlots, and brushland were common.

Dense cover rarely occurred in the fence rows. Seventy two percent of all fence rows were classed as No. I.

10. On the best ranges, coveys averaged 15.2 birds; on marginal to good ranges, 13.8 birds; and on submarginal ranges, 13.2 birds. The average over-winter losses per covey were 14 percent; 25 percent and 38 percent of the original covey, on good to excellent, marginal to good, and submarginal ranges respectively.
11. The utilization of cover and over-winter history of the game farm and wild trapped quail was similar to that of wild quail.
12. Fence rows were the favorite whistling areas of male quail.
13. Wastelands, brushland, and open areas adjacent to fence rows attracted many mated pairs of quail.
14. Fence rows of medium density and areas close to fence rows on well drained land were preferred as nest sites. Grass was the most important material used in nest construction.
15. Wheat and rye stubble was used as feeding areas by older birds while timothy stubble was preferred by birds of less than five weeks of age. Potato, tomato, pea, and bean fields attracted many broods during the summer months but the largest number of observations on young quail were made in young corn fields. When present,

orchards were heavily used by broods and adults in early fall.

16. Quail apparently dusted wherever exposed mineral soil was found.
17. During summer, broods preferred dense cover in which to roost, however, in the fall, alfalfa was the favorite roosting cover.
18. Thirty eight or 4.3 percent of the total number of birds under observation were taken by predators of all kinds. Seventy eight percent of all kills were made by house cats, unknown hawks, and dogs.

The differences in the protective quality of the cover on the different classes of quail range was not strikingly shown. This was probably due to the relatively good physical condition of the birds and the abundance of food and cover during both winters.
19. The central portion of the county, where dairy farms were common, was not as suitable for quail as the eastern and western portions. In the latter parts of the county, smaller fields and better distributed coverts were present.
20. The removal of corn for ensilage, pasturing of stubble fields, harvesting three crops of alfalfa annually, pasturing of woodlots, brushland and other waste areas, removal and thinning of fence rows and brush patches, and the burning of nesting cover in late spring were the most detrimental practices in Franklin County.

21. Quail Management in Franklin County should consist mainly of the modification of land use and treatment to suit the preferences and needs of quail.

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